



THE BLOOD SPACES OF THE PLACENTA.

Placenta and Uterine Wall showing Utero-Placental Blood Spaces and Circular Sinus.
Drawn life size. (*From Hunterian Collection, University of Glasgow.*)

COMBINED TEXTBOOK OF OBSTETRICS AND GYNÆCOLOGY

For Students and Medical Practitioners

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PREFACE TO THE FOURTH EDITION

ALTHOUGH this Fourth Edition follows closely upon its predecessor, yet the whole text has been revised and such alterations made as were necessary to bring it up to date.

Chapter XXIII, revised by Dr Ernest Landau, in which Analgesia and Anæsthesia are discussed, contains important alterations, as these subjects have been much in the limelight in recent years, more especially in relation to Obstetrics. This applies also to Chapter XXXII, in which Blood Transfusion is considered : here is included a reference to the Rh factor recently discovered.

Chapter XXXVIII, in which Professor McNeil deals with the "Health, Nutrition and Disorders of the Newly Born Infant," contains additional matter of interest. Chapter XLIII, in which Disorders of Function are considered, has been largely redrafted : particularly does this apply to the section on Sterility, which, with the assistance of Mr Green-Armytage, has been brought up to date. Here reference is made to "Contraception" for the first time, and its limitations defined. In Chapter XLV, where Gonorrhœal Infection is discussed, the modern treatment by sulphonamides is detailed.

Criticisms have been made on the relatively scanty space allocated to major gynæcological surgery by a number of reviewers of previous editions. It has been the agreed policy of the authors to adopt this course, as they do not consider that minute details of surgical technique should form part of the training of medical undergraduates for whom the "Combined Textbook" is more especially written. On the other hand, functional disorders and minor affections have been very fully considered.

The authors hope that the coloured illustrations introduced for the first time into this edition may interest readers and enhance the usefulness of the textbook.

THE AUTHORS.

EXTRACT FROM PREFACE TO THE FIRST EDITION

THIS volume is an attempt to correlate more closely Obstetrics and Gynæcology. The authors are of opinion that a combined textbook on these two subjects will impress the medical student with the importance of a thorough knowledge of obstetrics and with the fact that the great majority of ailments encountered in gynæcological practice are the result of infections and injuries contracted during parturition. They consider also that the arrangement in the present volume saves repetition which cannot possibly be avoided where the two subjects are dealt with in separate manuals.

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They also desire to express their appreciation of the new drawings by Mr Douglas J. Kidd and Mrs Moorhead Hamilton.

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CHAPTER I

ANATOMY OF THE FEMALE PELVIS AND THE EXTERNAL ORGANS OF GENERATION

THE details of structural anatomy are given more appropriately in textbooks on anatomy; in this place only a description of the facts which have a special bearing on obstetrics and gynaecology will be given.

FEMALE PELVIS

The pelvis is divided into two parts by the *pelvic brim*, which is formed by a line running circumferentially from the sacral promontory along the upper anterior margin of the sacrum, the sacro-iliac synchondrosis, arcuate or ilio-pectineal line, ilio-pectineal eminence, and upper margin of the pubes on each side. Above the brim is the false pelvis, below it is the true pelvis (Fig. 1).

The *false pelvis* has no great obstetric or gynaecological bearing. It is bounded behind by the lumbar vertebræ, laterally by the iliac fossæ and in front by the lower part of the anterior abdominal wall. It accommodates the growing uterus during pregnancy and it may be occupied by inflammatory swellings or tumours rising upwards from the pelvis.

The *true pelvis* lies below the pelvic brim, and a study of its shape and diameters is of supreme importance from the standpoint of child-bearing. Its structure will emerge during the description of the bony pelvis. It contains and protects the organs of generation in the non-pregnant condition.

The pelvis is composed of four bones: the two innominate bones, the sacrum and the coccyx.

THE INNOMINATE BONE.—Into the construction of each os innominatum there enter three bones: the ilium, the ischium and the pubes. Up to the age of seventeen these are separated by cartilage, but thereafter this disappears and the three bones fuse into one.

The Ilium.—The broad alæ of the iliac bones on each side form the side walls of the false pelvis. The iliac crest ends in front in the anterior superior spine (A.S.S.) and the diameter between the two A.S.S.—*interspinous diameter*—is always measured when the size of the pelvis is being gauged. The diameter between the widest points of the iliac crests—the *intercristal diameter*—is also of importance (Fig. 3).

The *ischium* forms part of the lateral wall of the true pelvis. Below it terminates in the ischial tuberosity, whilst about the middle of its posterior margin is the ischial spine.

In many dried pelvises it will be observed that on each inside lateral wall there runs a bony ridge from the ileo-pectineal eminence to the ischial spine. This ridge divides the lateral wall into an anterior and posterior inclined plane. At one time great importance was attached to these inclined planes in the mechanism of labour (*vide* p. 339). To-day only if the pelvis is narrowed laterally are these ridges and inclined planes regarded as of much significance.

The *os pubis*, with its fellow of the opposite side, forms the front portion of the true pelvis. The line of junction—the *symphysis pubis*—is a joint whose structures soften and expand to a small extent during

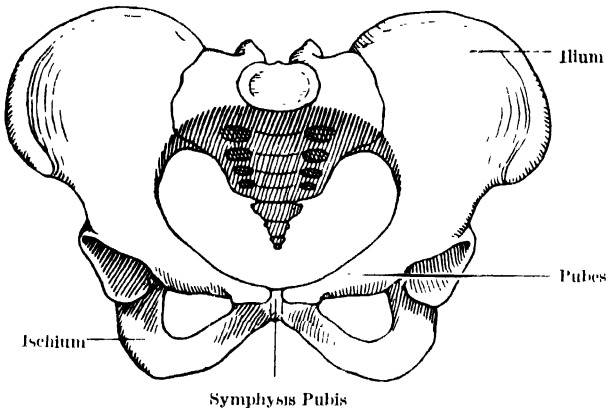


FIG. 1.—Pelvis shown from Front.

pregnancy and labour, thus rendering easier the escape of the foetal head (p. 121). The upper part of the pubis fuses with the ilium by means of its superior ramus, whilst below it unites with the ischium by means of its descending ramus. This, with the ascending ramus of the ischium, completes the pubic arch, which forms the front and part of the lateral margin of the pelvic outlet.

THE SACRUM.—This forms, with the coccyx, the posterior wall of the bony pelvis. It is composed of five fused vertebræ. The anterior and upper margin of the sacrum is prominent and bulges forward as the posterior margin of the pelvic brim—the *sacral promontory*. It is of paramount importance in the obstetrical anatomy of the pelvis.

The sacrum is concave from above downwards and from side to side. It unites with the ilium on either side at the sacro-iliac joint, the structures of which soften during pregnancy (*vide* p. 121).

THE COCCYX.—This small bone (formed of four fused vertebræ) is jointed to the sacrum. During expulsion of the child a certain backward rotation occurs owing to the softening of the articular

structures incidental to pregnancy. This backward movement allows of an increase of the pelvic outlet.

INCLINATION OF THE PELVIS.—When the woman is in the erect position the anterior superior spines and the pubic symphysis are in the same vertical plane. Approximately this position can be reproduced by placing the bony pelvis so that the anterior superior spines and the front of the pubic symphysis are simultaneously touching a flat vertical surface—*e.g.* a wall.

In the erect position the plane of the pelvic brim forms an angle of 50 to 60 degrees with the horizon—it is, however, subject to great variations (pp. 512, 514, 525).

PLANES OF THE PELVIS.—For convenience in describing the position of the presenting part of the child at any stage of labour, the pelvic cavity is imagined to possess certain planes: (1) the plane of the

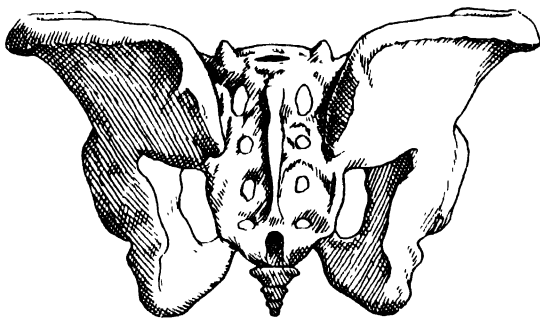


FIG. 2.—Pelvis shown from Behind.

brim, or *superior strait*; (2) the plane of the outlet, or *inferior strait*; and (3) the maximum plane of the cavity.

The *plane of the brim* bounds the cavity of the true pelvis above. It is roughly shaped like a heart, with a rounded projection behind, corresponding to the sacral promontory. It is bordered behind by the sacral promontory and alæ, laterally by the ilio-pectineal lines, and in front by the horizontal rami and upper margin of the symphysis of the pubes. The term plane as applied is somewhat of a misnomer, because the lateral margins are at a slightly lower level than its centre.

As we have seen, the plane of the brim forms an angle of 50 to 60 degrees with the horizon.

The *plane of the outlet* is bounded behind by the tip of the coccyx, laterally by the great sacro-sciatic ligaments and tubera ischii, and in front by the lower margins of the pubic arch. Even more than the plane of the brim, it is not a flat plane, for the coccyx and the lower margin of the pubic symphysis are at a higher level than the tubera ischii.

The lower margin of the pubic symphysis lies at a lower level than

the tip of the coccyx, to the extent that the antero-posterior diameter of the outlet forms an angle of 10 degrees with the horizon.

The *maximum plane of the cavity* corresponds to the part of the cavity that possesses the largest area. It extends between the second and third sacral vertebræ behind, to the middle of the pubic symphysis in front.

AXIS OF THE PELVIS.—The axis of the bony pelvis is the imaginary line joining the central points of all the imaginary antero-posterior diameters of the pelvic canal. With the soft parts *in situ* in the living subject the *axis of expulsion of the child* is curved so that in its upper part it passes downwards and backwards; its middle part passes downwards; whilst its lower portion sweeps downwards and forwards. When this is dilated in labour it is thus a curved line which passes along the centre of the pelvic canal from brim to vaginal outlet (p. 36).

MEASUREMENTS OF THE PELVIS

Successful obstetrics necessitates a measurement of the bony pelvis, so that any diminution in size below the normal can be gauged. One of the most important causes of difficult labour is pelvic contraction. By careful measurement in pregnancy, dystocia can be anticipated and prepared for by means to be described in subsequent chapters.

The size of the pelvis is gauged by external and internal measurements, and by radiography.

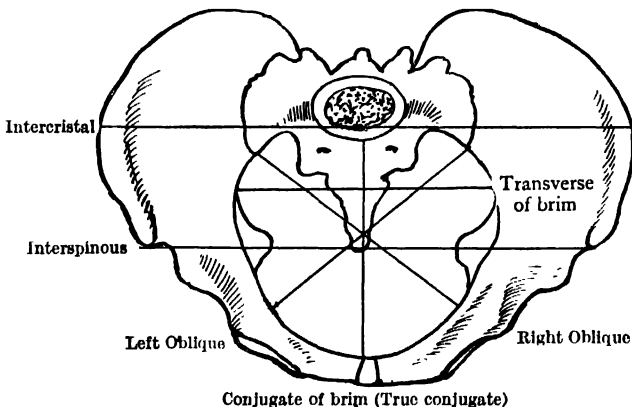


FIG. 3.—Diameters of False Pelvis and of Pelvic Brim.

EXTERNAL MEASUREMENTS.—The diameters that are measured externally are the (1) interspinous; (2) intercristal; (3) external conjugate; (4) intertrochanteric. These measurements are made by an instrument called a pelvimeter (p. 522).

The *interspinous diameter* is the distance between the anterior superior iliac spines (A.S.S.). Its length is 10 inches (25.0 cm.) (Fig. 3).

The *intercristal diameter* is the distance between the widest points of the iliac crests. Its length is 11 inches (27.5 cm.) (Fig. 3).

The *external conjugate diameter* is the distance between the upper margin of the symphysis pubis and the tip of the spine of the last lumbar vertebra. Its length is $7\frac{1}{2}$ inches (19 cm.). By subtracting $3\frac{1}{2}$ inches (9 cm.) from the measurement thus made one obtains 4 inches (10 cm.), the approximate size of the antero-posterior diameter (conjugate) of the brim. Obesity and variations in thickness of bones tend to nullify this measurement, so it is only of secondary value in calculating the capacity of the pelvis.

The *intertrochanteric diameter* is the distance between the tuberosities of the ischia.

INTERNAL MEASUREMENTS.—These measurements concern the true pelvis and are given in terms of the diameters of the skeleton. Some of them are of special clinical value, and their significance and the method of obtaining them will be given in a later chapter (Chapter XXX). In life the covering of soft parts encroaches on all the bony diameters.

The diameters of the true bony pelvis are usually described: (1) at the brim; (2) at the cavity; (3) at the outlet.

DIAMETERS OF THE BRIM (Fig. 3).—

The *antero-posterior* or *conjugata vera* (C.V.) is measured from the sacral promontory to the upper margin of the symphysis pubis. Its length is $4\frac{1}{4}$ to $4\frac{1}{2}$ inches (10.6 to 11.2 cm.).

The *transverse diameter* is measured between the widest points on the ilio-pectineal lines. It lies much nearer the promontory than the pubes. Its length is 5 to $5\frac{1}{4}$ inches (12.5 to 13.1 cm.).

The *oblique diameters* are measured on each side between the sacro-iliac synchondrosis of one side and the ilio-pectineal eminence of the opposite side. That from the right sacro-iliac joint is called the *right oblique*; that from the left sacro-iliac joint, the *left oblique*, diameter. Their length is $4\frac{1}{2}$ to 5 inches (11.2 to 12.5 cm.).

DIAMETERS OF THE CAVITY.—These are measured at the level of the maximum plane of the cavity. The antero-posterior is thus measured between the second and third vertebræ of the sacrum and the centre of the posterior surface of the pubes.

The diameters of the cavity all measure $4\frac{1}{2}$ to 5 inches (11.2 to 12.5 cm.).

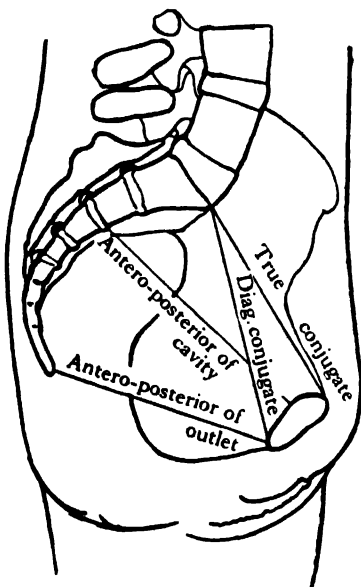


FIG. 4.—Diameters of True Pelvis.

DIAMETERS OF THE OUTLET.—The *antero-posterior diameter* passes between the tip of the coccyx and the centre of the lower margin of the symphysis. Its length is 5 inches (12·5 cm.), though this is increased by $\frac{1}{2}$ inch (1·2 cm.) during labour by the backward rotation of the coccyx. The *transverse diameter* is measured between the inner surfaces of the tubera ischii. Its length is 4 inches (10 cm.).

The following Table is a summary of the measurements of the pelvic diameters :—

		TABLE OF MEASUREMENTS.		
		In Inches. Centimetres in Brackets.		
		Conjugate.	Oblique.	Transverse.
Brim . .		4 $\frac{1}{2}$ to 4 $\frac{1}{2}$ * (10·6 to 11·2)	4 $\frac{1}{2}$ to 5 (11·2 to 12·5)	5 to 5 $\frac{1}{2}$ (12·5 to 13·1)
Cavity . .		4 $\frac{1}{2}$ „ 5 (11·2 „ 12·5)	4 $\frac{1}{2}$ „ 5 (11·2 „ 12·5)	4 $\frac{1}{2}$ „ 5 (11·2 „ 12·5)
Outlet . .		5 „ 5 $\frac{1}{2}$ + (12·5 „ 13·7)	...	4 „ 4 $\frac{1}{2}$ (10 „ 10·6)

* Obstetrical conjugate.

† Coccyx turned back as in labour.

MOBILITY OF PELVIC ARTICULATIONS

This subject is fully discussed in the opening paragraphs of Chapter VI, in which the softening of the joints and increased capacity of pelvis, the result of pregnancy, are described.

EXTERNAL GENITAL ORGANS—VULVA AND PERINEUM

The external genital organs or *vulva* of the female (Fig. 5) consist of :

Mons Pubis or Veneris.

Labia Majora.

Labia Minora.

Clitoris.

Vestibule and External Urethral Meatus.

Hymen and Vaginal Orifice.

Perineum.

MONS PUBIS OR VENERIS.—This is a pad of fat which lies in front of the pubes and is covered by skin containing crisp wavy hair. In men the pubic hair passes upwards in a tapering line towards the umbilicus, but in women it is confined to the mons. Sometimes, however, in women the male arrangement is found. Below, the mons veneris passes into the labia majora.

LABIA MAJORA.—The labia majora consist of rounded elongated folds of skin projecting downwards and backwards from the mons veneris. In front they fuse in the *anterior commissure*, whilst behind they unite in the middle line in front of the anus to form the *posterior commissure*. The latter is usually indistinct, and in women who have

borne children it is, as a rule, absent. The labia majora are in contact whilst the legs are together. Their inner surfaces are covered by moist skin, their outer surfaces with hair.

LABIA MINORA.—These are only exposed completely when the labia majora are separated. They are two thin folds of skin running downwards and backwards on each side just within the larger labia. They are covered by moistened skin and often project by their free margin beyond the labia majora. This free margin is usually ridged and serrated like a saw. Above and in front the labium minus on each side divides into two narrow folds. The upper of these passes over the clitoris to

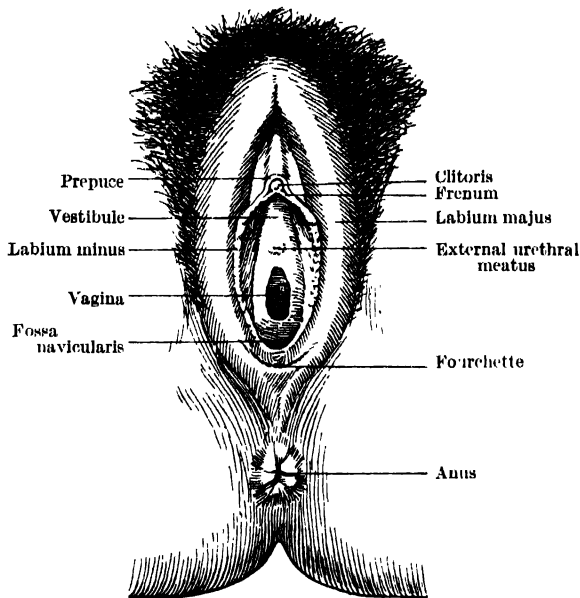


FIG. 5.—Female External Genital Organs.

join the corresponding fold from the other labium minus—*prepuce of the clitoris*. The lower portion unites with its fellow from the opposite side under the clitoris—*frenum of the clitoris*. The labia minora fuse across the middle line behind the vagina to form a fold which is thrown into a sharp ridge when the labia are separated—*fourchette*. This usually disappears after the birth of the first child. Between it and the vaginal orifice is situated a boat-like depression—*fossa navicularis*.

CLITORIS.—This organ corresponds to the penis of the male, and in its general structure resembles a miniature phallus. It lies in the mid-line just below and behind the mons and anterior commissure. It hangs free as a small elongated organ ending like the penis in a rounded glans. On dissection this can be shown to be continuous with a thin elongated band of erectile tissue which passes downwards and backwards under the mucous membrane of the vestibule and then

separates into two bulbous masses of the same class of tissue which lie on either side of the vaginal orifice. These are called the *bulbi vestibuli* (Fig. 7) and correspond structurally to the bulb of the male urethra. Their forward prolongations unite to form the band of erectile tissue that bends forwards to expand into the glans of the clitoris. This band is called the *pars intermedia* and corresponds with the corpus cavernosum urethræ of the male.

VESTIBULE AND EXTERNAL URETHRAL MEATUS.—All the structures internal to the labia minora are covered by mucous membrane, the line of junction between skin and mucosa being the inner margins of the lesser labia on each side, the lower margin of the frenum in front and the anterior edge of the fourchette behind.

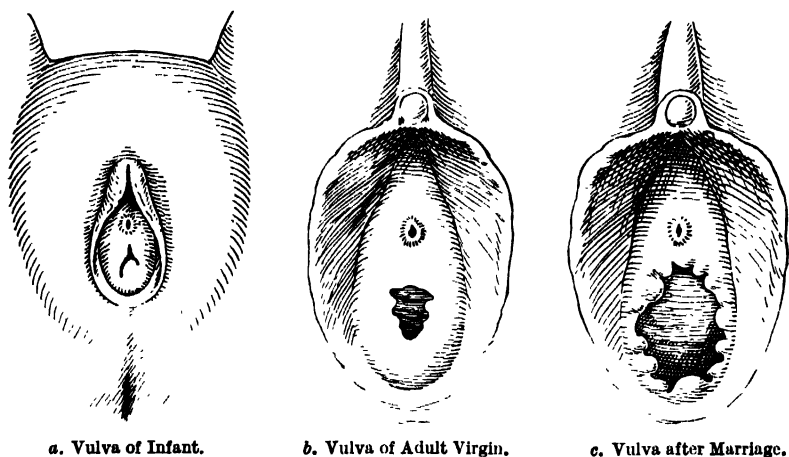


FIG. 6.

The *vestibule* is the triangular surface whose apex is above at the clitoris and whose base is below at the anterior line of attachment of the hymen. On each side it extends as far as the labium minus. It is about one inch long. At the centre of its base the urethra opens on a small elevated surface of mucous membrane—*external urethral meatus*. In the natural condition the vestibule is concealed by the labia, and it is folded on itself so that it forms a narrow slit passing from behind forwards towards the clitoris.

HYMEN AND VAGINAL ORIFICE (Figs. 5, 6).—The hymen is an incomplete septum of mucous membrane which closes over the vaginal orifice. It is formed of two lateral folds like diminutive labia, which are united above and below. When the legs are apposed they lie against one another, and in this way the narrow opening of the vaginal orifice is closed.

The vaginal orifice in the virgin is a small longitudinal slit running from behind forwards. Its size and shape vary in different individuals, depending on the state of the hymen. Usually it is a small single

opening. In some cases it is perforated by several openings—cribriform hymen. In abnormal cases the hymen may be imperforate.

With the consummation of marriage the hymen is stretched or torn, and in the latter case its remaining tags are called *carunculæ myrtiformes*. This is always the condition of the hymen in parous women.

From the medico-legal standpoint it should be remembered that coitus does not always cause rupture of the hymen, for penetration and actual conception can occur as the result of a stretching of the

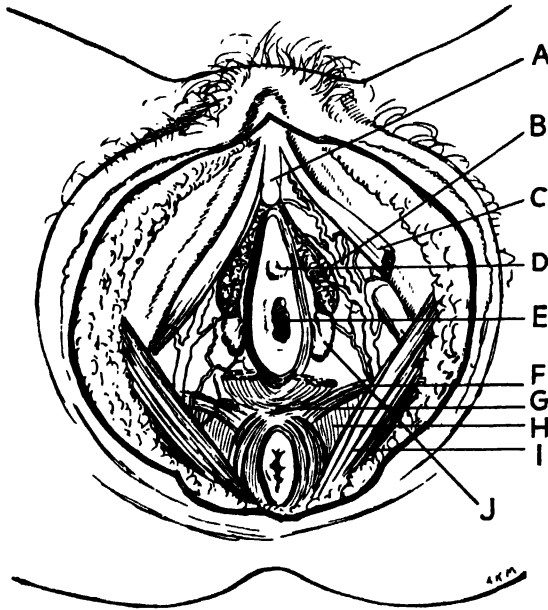


FIG. 7.—Deep Dissection of Pelvic Floor.

- | | | |
|---------------------|-------------------------|-----------------------|
| A. Clitoris. | D. Urethra. | H. Levator Ani. |
| B. Bulbi Vestibuli. | E. Orifice of Vagina. | I. Gluteus Maximus. |
| C. Crus Clitoridis. | F. Transversus Perinei. | J. Bartholin's Gland. |
| | G. Perineal Body. | |

hymen merely. In other cases conception has occurred with an imperforate hymen.¹

PERINEUM.—From the obstetrical and gynæcological standpoint the perineum is defined as the wedge-shaped area intervening between the lower end of the vagina and the rectum.

BARTHOLIN'S GLANDS (Fig. 7).—These are a pair of small bean-shaped glands lying at the sides of the lower end of the vagina and overlapped by the lower end of the bulb of the vagina. They are the homologues

¹ Two of the authors (Munro Kerr and Hendry) witnessed a case of early pregnancy in which the hymen showed no perforation whatsoever, but on examination under anæsthesia there was discovered a small opening just within the meatus of the urethra—through this opening a probe could be passed into the vagina. The medico-legal importance of such a condition is obvious.

of the Cowper glands in the male. Their structure is that of a compound racemose mucous gland, the gland spaces being lined by a columnar epithelium. The gland can be felt only if it is enlarged by tumour growth or inflammation. The duct is narrow and opens on the inner side of the labium minus near its posterior end. The lining of the duct is formed by stratified epithelium except in its deeper part, where it consists of a single layer of columnar cells.

CHAPTER II

ANATOMY OF THE REPRODUCTIVE ORGANS—(continued)

INTERNAL ORGANS OF GENERATION

THE internal genital organs of the female are: (a) Vagina; (b) Uterus; (c) Uterine or Fallopian Tubes; (d) Ovaries.

VAGINA

The vagina is not a straight canal but is curved like an open S. It extends upwards and backwards from the vulva approximately parallel to the plane of the pelvic brim—i.e. it makes an angle of about 50 degrees with the horizon when the subject is in the erect position (Fig. 9). The vaginal walls are anterior and posterior, and these are normally in apposition, so that the canal is really a transverse or H-shaped slit traversing the pelvis (Fig. 8). The lower end of the canal is somewhat narrower than the upper end, which expands to receive the vaginal portion of the cervix uteri. This projects downwards and backwards into the vagina, carrying with it a cone-shaped covering of mucous membrane from the invaginated vagina.

The annular fossa in the vaginal vault which surrounds the cervix is divided for purposes of description into four regions or *fornices*—*anterior fornix*, *posterior fornix*, and *right* and *left lateral fornix*. This description is convenient for denoting the position and relationship of the structures felt through the vaginal vault during an examination with the fingers. A structure is said to be felt through the anterior fornix if it is felt when the fingers are pressed upwards in this region, and so on. Because of the manner in which the cervix is inserted into the vaginal vault, the posterior fornix seems to be deeper to the examining fingers than the anterior fornix.

RELATIONS OF VAGINA.—*In front* it is related in its upper part to the bladder, which is here close up against the vaginal wall, though the two structures can be easily separated. In its lower part the anterior vaginal wall is closely related to the urethra, which is actually imbedded in the muscular wall of the vagina (Figs. 8, 9).

Behind, the vagina is related in its upper third to the pouch of Douglas. The finger placed in the posterior fornix is separated from the peritoneal cavity only by the thin septum formed by vaginal wall and peritoneum. In its middle third it is related to the rectum;

normally the vagina strips easily from the bowel. In its *lower third* it is related to the perineal body (Fig. 9).

Laterally, the vagina is related at its vault to the connective tissue which surrounds the portion of the cervix above the vagina. Just above the lateral fornix the *ureter* on each side courses forward and inward and downward in this connective tissue towards the trigone of the bladder (Figs. 9, 20). The *lateral wall* of the vagina is related to the levator ani muscle—these muscles support the vagina.

STRUCTURE OF VAGINA.—The lining walls of the vagina are rugose ;

a longitudinal fold traverses the anterior and posterior walls in the middle line. From the central folds subsidiary transverse folds extend outwards to encircle the vagina. These folds are more marked in the infant and in the nulliparous woman than in the woman who has had children. They are often most marked low down on the anterior wall.

The canal of the vagina is lined by *squamous epithelium* continuous, below, with the squamous epithelium of the vulva and, above, at the external os of the cervix, with the glandular epithelium of the uterus. The vaginal mucosa contains no glands ; despite

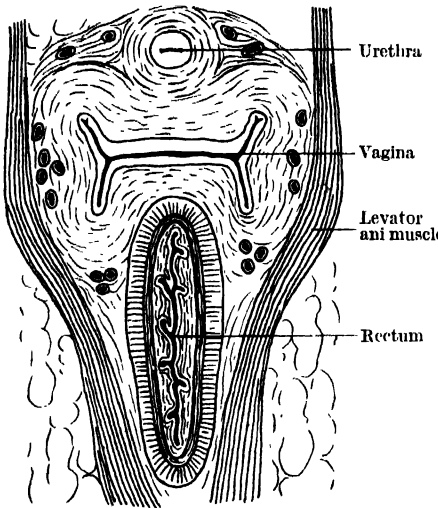


FIG. 8.—Horizontal Section through the Urethra, Vagina and Anal Canal, a short distance above their terminations (Henle).

this the walls are always moist, being lubricated by the secretion which trickles down from the uterus and by a fluid which transudes through the vaginal walls.

External to the mucosa the vaginal walls are fibromuscular. The muscle fibres are of the unstripped variety.

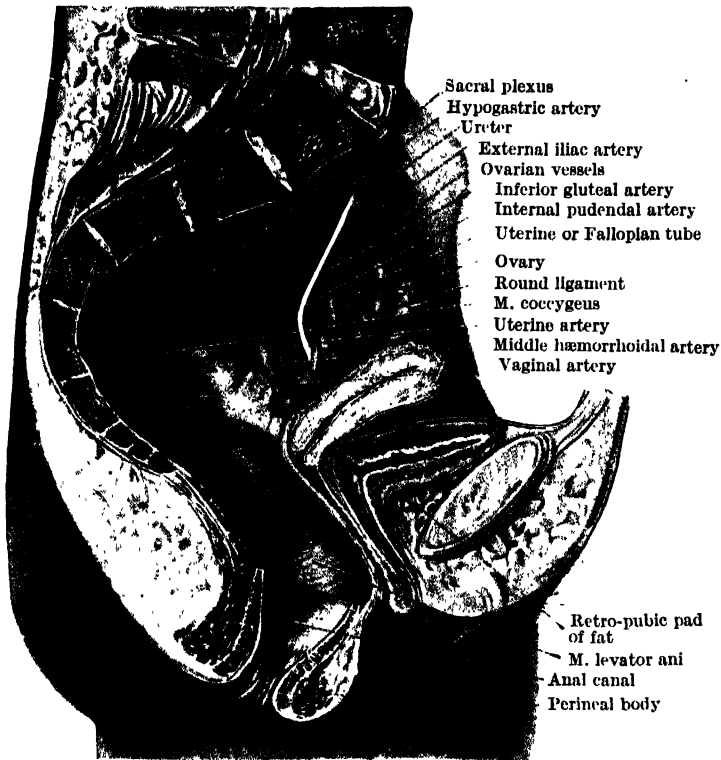
The vessels, lymphatics and nerves of the vagina are described on a later page.

UTERUS

The uterus or womb is the child-bearing organ. It is shaped like a pear flattened in front, the larger end of the pear being uppermost—the *corpus* or *body*—where it projects free into the peritoneal cavity. The narrow end of the pear is below ; it is somewhat cylindrical in shape and it projects into the vaginal vault—the *cervix* or *neck*. Between body and neck there is a distinct area—the *isthmus*.

The uterus occupies a central position in the pelvis, with its upper

end just below the plane of the pelvic brim and its lower end at the level of the ischial spines. Its anterior surface rests on the bladder. The organ enjoys a considerable latitude of movement in health. For example, when the bladder distends it is lifted upwards and backwards, but when the pelvic colon distends it is pressed downwards and forwards. Likewise the uterus moves up and down with the pelvic



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FIG. 9.—Dissection of a Median Section of a Female Pelvis, showing the Pelvic Diaphragm and the Structures on the Side Wall of the Pelvis behind the Broad Ligament.

floor during the respiratory movements imparted to the abdominal contents. With a volsella fixed to the cervix the healthy uterus can be drawn downwards till its external os is level with the vulva.

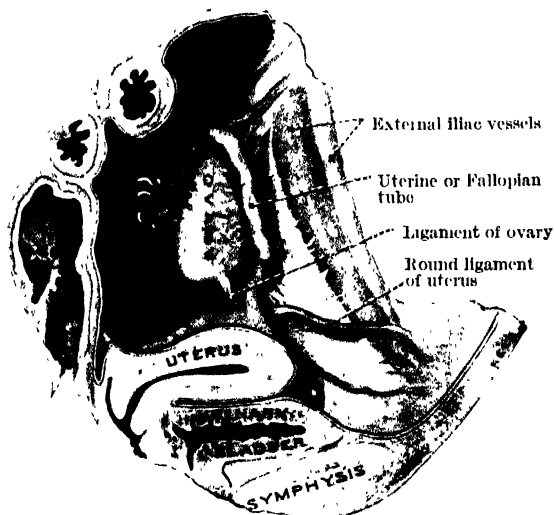
The uterus is not vertical but has a forward pitch—*anteversion*—whilst the body and cervix make with one another an obtuse angle which opens forwards—*anteflexion*. In the erect position, with the bladder empty, the long axis of uterus is approximately horizontal.

MEASUREMENTS OF UTERUS.—The total *length* from summit to external os is 3 inches (7.5 cm.). Of this 2 inches (5 cm.) are formed by body, 1 inch (2.5 cm.) by cervix. The *breadth* at its upper end is 2 inches (5 cm.), at its lower end 1 inch (2.5 cm.). The antero-posterior

thickness is 1 inch (2·5 cm.). The thickness of each wall is $\frac{1}{2}$ inch (1·2 cm.). From this it is apparent that the total length of the cavity is $2\frac{1}{2}$ inches (6·2 cm.). All measurements are fractionally greater in a woman who has borne a child.

CORPUS UTERI—BODY OF UTERUS

The anterior surface of the body is less convex than the posterior, and the upper end is wider than the lower end, which narrows towards the cervix. The external length of the body is 2 inches (5 cm.); the length of its canal is $1\frac{1}{2}$ inches (3·7 cm.).



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FIG. 10.—Left Side Wall of Female Pelvis to show position of Uterus and the Ovary. The ovary is much scarred owing to the shedding of ova.

RELATIONS.—The *Fallopian tube* opens into the body on each side just below the upper *cornu*. The part above the tubal insertions is called the *fundus*. Just below and in front of the tube on each side the *round ligament* is attached, and behind, at about the same level, the *ovarian ligament* (Figs. 10, 11).

In front and below, the body lies against the upper free part of the bladder; between the two organs is the *utero-vesical pouch* of peritoneum. Behind and above, the body is related to small bowel and sometimes to a coil of large bowel.

At its lower end the body passes into the cervix at the isthmus.

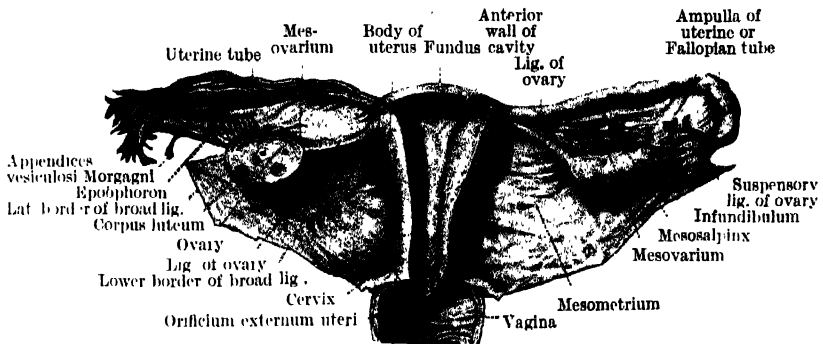
STRUCTURE.—The body has a covering of peritoneum. Internal to this is the muscular wall, while on the inner aspect of the muscle is the mucous membrane lining the cavity.

The *peritoneum* invests the body completely except along the sides,

where it is carried off the womb as the two leaves of the *broad ligament*.

The Muscular Wall.—This forms the main mass of the uterus. It consists of unstriped muscle fibres supported by a basis of connective tissue. In the pregnant uterus the muscular fibres have been described as arranged in three layers : (a) an outer, in which they run longitudinally ; (b) an intermediate, in which they run irregularly (in this layer the main venous sinuses of the uterine wall course during the pregnant state) ; (c) an inner, in which the fibres run circularly. This layer is specially developed round the orifices of the Fallopian tubes and the internal os.

The *cavity* of the body in the resting uterus is a potential space dividing the body into an anterior and posterior wall which are ordinarily



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FIG. 11.—The Uterus, the Uterine Tubes, the Ovaries, the Broad Ligaments, and the upper part of the Vagina, seen from behind. The posterior wall of the uterine cavity has been removed, and the left uterine or Fallopian tube and the upper part of the vagina have been opened.

apposed, as seen in a longitudinal sagittal section. On coronal section the cavity is triangular, with the angles formed by the two tubal openings above and the *internal os* below, where the canal narrows into the cervix. The cavity at the upper angles passes outwards towards the tubes. The two lateral areas of the body at this level are called the *cornua* (Fig. 11).

Mucous Membrane or Endometrium.—This lines the cavity of the body. At its upper end it is continuous with the mucous linings of the Fallopian tubes, whilst below it is continuous with the mucous lining of the isthmus.

The endometrium is a soft pinkish tissue about $\frac{1}{10}$ inch (2 mm.) in thickness in the pre-ovulation phase. During the reproductive life of a woman, except during the periods of pregnancy and lactation, the mucosa is in a constant state of ebb and flux in response to the changes which characterise the menstrual cycle. These cyclic changes will be described in a later chapter. Here we will limit our attention to the pre-ovulation phase (p. 46).

The mucosa is composed of stroma and epithelium (Fig. 12). The *stroma* consists of loosely arranged spherical and spindle-shaped cells which may be considered as a form of embryonic connective tissue, but which also has been described as lymphoid tissue. These stroma cells are united by branching protoplasmic processes between which are intercellular spaces filled with lymph. The blood-vessels coursing through the stroma run towards the surface from the muscular wall of the uterus. It is interesting and significant to note that the vessels,



FIG. 12.—Microscopic Appearance of Endometrium.

except in the deeper layers of the mucosa, where they emerge from the muscle, are completely unprovided by the supporting elements which even small vessels possess in other parts of the body. They have no muscle or fully formed fibrous tissue. They are, in fact, merely capillaries, with a certain amount of condensation of the soft stroma round them. This arrangement, however, is only temporary, for, during menstruation, and in early pregnancy, the vessels can open readily by a teasing apart of their walls to allow of a free exit of the blood into the surrounding areas. The peculiar structural character of the stroma, in fact, is devised for the purpose of ensuring an immediate suffusing of any part of the mucosa in which an ovum is implanted with a liberal supply of blood.

The *epithelium* consists of columnar ciliated cells. It covers the entire surface and projects down into the mucosa in the form of simple tubular glands. The epithelium of the glands is not ciliated. The glands pursue a course more or less at right angles to the surface. Some of them extend as far as the muscular wall and end in slightly expanded terminations among the more superficial muscular fibres. The gland ends have an envelope of stroma. When the glands are cut clean across they show under the microscope as circular spaces. When cut in their length they show as elongate tubes usually somewhat tortuous. (For the description of the cyclic changes in the glands and stroma, see p. 46, and for the secretion from the glands, see p. 48.)

In the *infant* there are few glands. The epithelium covering the mucous membrane of the uterus is for the most part flat, with here and there small superficial depressions representing primitive glands. It is not till the approach of puberty that there takes place a rich development of glands by numerous invaginations from the surface epithelium.

CERVIX UTERI

This is the lower part of the womb, commencing above at the isthmus, and ending below in a cone-shaped portion which projects into the vaginal vault. Its total length is 1 inch (2.5 cm.).

The cervix is divided into two portions: (a) supravaginal: (b) vaginal (Fig. 13).

SUPRAVAGINAL PORTION.—This is cylindrical in shape. In front it lies against the bladder, to which it is loosely attached. *Behind*, the supravaginal cervix is covered by peritoneum and is related to the pouch of Douglas. Laterally it is related to the musculo-connective tissue in which the uterus is imbedded—*parametrium*. The ureter on each side passes downwards, forwards and inwards in this connective tissue to the bladder. The ureters converge as they pass forward, and whilst behind they are about $\frac{3}{4}$ inch (1.9 cm.) from the cervix, further forward they are as near to it as $\frac{1}{2}$ inch (1.2 cm.).

VAGINAL PORTION.—In the nullipara the vaginal portion is small and cone-shaped, the narrow end being below, where it terminates in the circular *external os*. In a parous woman the vaginal cervix is larger and the os is opened out transversely so that it possesses an *anterior lip* and a *posterior lip* (Fig. 14). At the same time there is often in such women a tear extending from the os outwards into

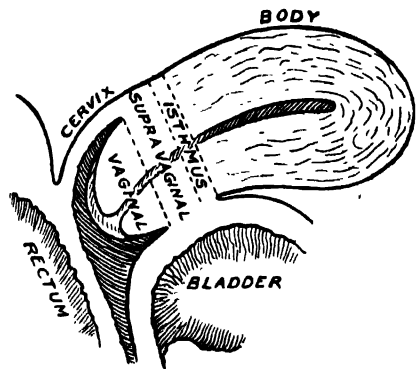


FIG. 13.—Showing how the Uterus is divided and the area occupied by the Isthmus.

the cervical tissue on one or both sides. It should be remarked, however, that it is possible for a woman to have a full-time baby with

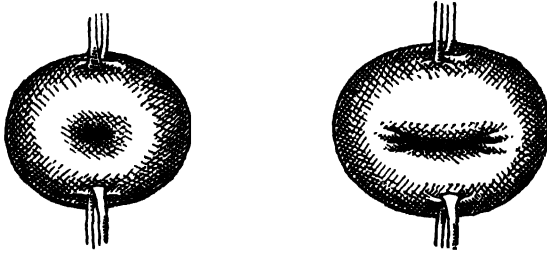


FIG. 14.—Nulliparous and Parous Cervix.

few or no signs in the cervix to distinguish it from the nulliparous condition, a fact which may sometimes be of medico-legal importance.

The cavity of the cervix is circular on transverse section. When cut longitudinally it is found to be spindle-shaped, narrowing above and below at the internal and external os respectively (Fig. 11).

Fibromuscular Wall of Cervix.—

The cervix contains a larger relative admixture of fibrous tissue than the body, and for this reason it is firmer in consistence than the body. The cervix does not require such a rich provision of muscular tissue, for during labour its dilatation is largely passive in nature.

Mucous Membrane of Cervix.—

The canal of the cervix is lined by (a) a glandular mucous membrane. The vaginal surface of the cervix is covered by a cap of (b) squamous epithelium continued on to it from the epithelial lining of the vagina. This latter mucous membrane requires no special description.

The mucous membrane lining the cervical canal is composed of a stroma of connective tissue covered by a layer of columnar epithelium and supporting a number of glands.

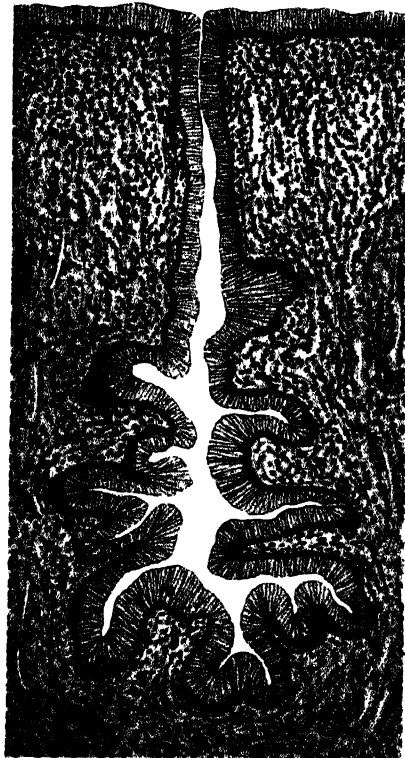


FIG. 15.—Microscopic Structure of Gland of Cervix and covering Epithelium.

The stroma is more fibrous and therefore denser than the stroma of the endometrium. The epithelium that lines the surface and the glands consists of long, thin, columnar cells closely packed together

with their nuclei close up against the basal portion of the cells. To this type of epithelium the name of palisade epithelium is given (Fig. 15). The epithelial cells covering the summits of the folds of the mucosa are ciliated. The cervical glands are racemose, the acini of each gland opening on the surface by a single duct. The secretion from these glands is described elsewhere (p. 123).

ISTHMUS UTERI

The illustration here presented (Fig. 16) is taken from Stieve's¹ monograph on the cervix. He and Fränkl² have demonstrated that

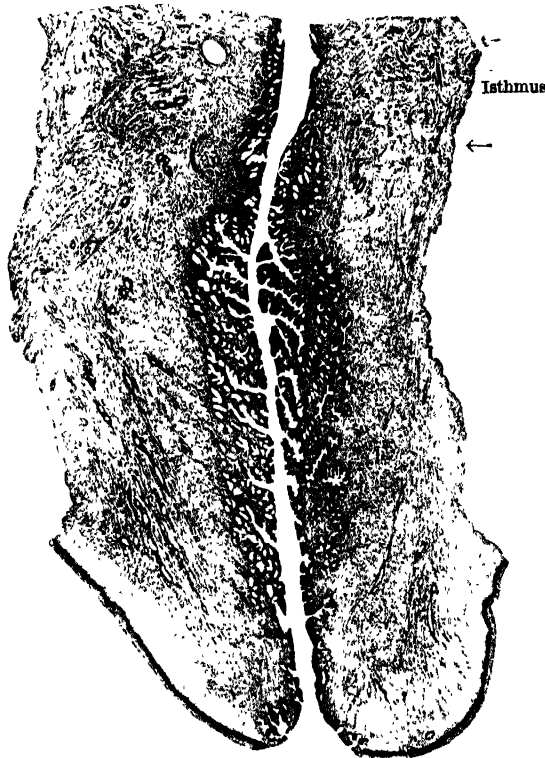


FIG. 16.—Cervix and Isthmus of a Seventeen-year-old Maiden Sixteen Days after the Last Menstrual Period.
($\times 36$.)

As a result of fixation the wall of the isthmus has shrunk so that the canal of the isthmus appears wider than it is actually. (Stieve.)

this particular area has special anatomical features even in the young nulliparous woman ; further, that it is this area that becomes stretched out in the later weeks of pregnancy and labour, and becomes the "Lower Uterine Segment." Its lower boundary is clear-cut from the

¹ *Der Halsteil der menschlichen Gebärmutter*, Leipzig, 1927.

² *Journ. Obst. and Gyn., Brit. Emp.*, 1933, vol. xl., p. 397.

cervix, but its upper limit is not so sharply defined. In the non-gravid adult it has a depth of 4 to 6 mm. The epithelium covering is very similar to that of the body, but the cells are a little flatter, the nuclei are relatively larger and the glands are less abundant. During the premenstrual phase of the menstrual cycle (p. 47) its mucous membrane does not become so swollen nor do the glands become so tortuous. The proportion of fibrous to muscular tissue is relatively greater than in the body, it contains few blood-vessels, and lastly, the glycogen content of the cells is low as compared to that of the body. It is an unsuitable site for the imbedding of the zygote (placenta prævia, p. 573), but a peculiarly suitable area in which to perform Cæsarean section (p. 726).

The blood-vessels, lymphatics and nerves of the uterus are described on a subsequent page.

FALLOPIAN OR UTERINE TUBES

The Fallopian tubes or oviducts convey the ova from the ovary to the uterus and they transmit the sperm-cells upwards to meet the descending ova. It is probable that fertilisation normally occurs in the Fallopian tube.

They extend, one on each side, from the cornua of the uterus outwards for a distance of 4 or 4½ inches (10 or 11 cm.). The course of the tube is not straight but tortuous. Thus at first it passes outwards. It then turns backwards and downwards and inwards, partly encircling the ovary. The terminal end of the tube often abuts against the surface of the ovary (Figs. 10, 11).

The tube is situated within the upper edge of the broad ligament during the first part of the course. When it turns backwards it leaves the broad ligament, though it carries with it a peritoneal investment derived from the posterior layer of this ligament.

For description the tube is divided into four portions: (a) *interstitial*; (b) *isthmal*; (c) *ampullary*; (d) *fimbriated*. The *interstitial portion* is the part which channels the uterine cornu. The *isthmal portion* (isthmus) is the narrow part immediately beyond the uterus. The *ampullary portion* (ampulla) lies beyond the isthmus. It is the widest part of the tube. The *fimbriated end* (infundibulum) is the outermost end of the tube. It opens directly into the peritoneal cavity by an *ostium* surrounded by a loose radiating series of *fimbriæ* or tapering tags of mucous membrane. By this arrangement the abdominal ostium is enlarged to its widest limit to facilitate the reception of the ova as they are detached from the ovary. One of the fimbriæ is longer than the others and is attached to the outer surface of the ovary (fimbria ovarica). Associated with one fimbria is often found a small cyst (Hydatid of Morgagni).

The tube consists of a muscular channel lined by mucous membrane.

Its isthmal and ampullary portions are invested with the peritoneum of the broad ligament, which is related to the tube somewhat like the mesentery of the bowel and for this reason is called the *mesosalpinx*.

MUSCULAR WALL.—The interstitial portion is surrounded by the unstripped muscular tissue of the uterine cornu which it channels. The unstripped muscular tissue in the free portion of the tube is arranged in two layers: (a) an outer longitudinal; (b) an inner circular.

MUCOUS MEMBRANE.—When cut in transverse section the tube is found to be lined by a mucous membrane composed of a connective tissue stroma covered by a columnar ciliated epithelium. These two elements are similar in their characters to the corresponding structures in the endometrium.

The tube lumen is not circular, the mucous membrane being raised in a series of folds which pass the entire length of the tube from uterus to fimbriated end. The appearances thus presented are revealed in their simplest form if a transverse section is made across the interstitial portion of the tube. It is then noticed that the lumen is stellate, the mucosa being raised into four or five simple ridges. A similar arrangement is present in the

isthmal portion. In the ampulla a very remarkable appearance is presented on transverse section. The tube lumen is now greatly increased in size and it is occupied by a complicated series of branching mucous folds and processes which produce an intricate arborescent structure. Examination, however, reveals the fact that there are again four or five primary folds, and that the elaborate structural characters are due to the rich branching and division which each primary fold possesses (Fig. 17).

At the outermost end the fimbriæ in their turn consist of the outward projection beyond the ostium of the branching folds of the ampulla.

There are no glands in the tube; the spaces between the mucosa

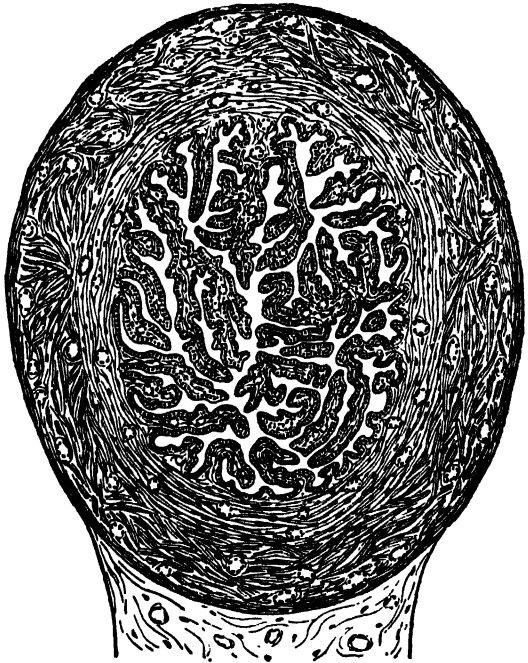


FIG. 17.—Transverse Section of Ampulla of Fallopian Tube.

processes are really continued as channels throughout the whole length of the tube.

The cilia of the tube move in such a way as to maintain a constant stream of fluid from peritoneal cavity towards uterus, and in this way an ovum discharged from the ovary is carried automatically on the moving stream to the uterus. It is possible that the peristaltic contraction of the muscle walls of the tube has a certain influence in the same direction.

The blood-vessels, lymphatics and nerves of the tubes will be described subsequently.

OVARIES

The ovaries or egg-producing organs are two almond-shaped bodies measuring $1\frac{1}{2}$ inches (3·7 cm.) by $\frac{3}{4}$ inch (2 cm.) by $\frac{1}{2}$ inch (1·2 cm.). The ovary on each side lies up against the side wall of the true pelvis just below the brim and behind the broad ligament, to which it is slung by a short fold of peritoneum—*mesovarium*. The position of the ovary varies somewhat in different individuals and in the same individual at different times. It shares in any movement of the broad ligament and uterus. The structures that maintain the statics of the ovary are the broad ligament and mesovarium. The pelvic end of the broad ligament is sometimes called the *suspensory ligament of the ovary*. The ovary is slung in place also by the *ovarian ligament*, a rounded cord of fibro-muscular tissue which extends from the upper end of the lateral wall of the uterus, just below and behind the tube, to the inner or uterine pole of the ovary. This structure is recognised by its whitish appearance. In addition the ovarian fimbria of the tube is fixed to the outer or tubal pole of the ovary. On the average the ovary lies with its long axis vertical (Figs. 10, 11).

Up to puberty the SURFACE of the ovary is smooth and shining. After the commencement of menstruation the surface becomes roughened and puckered by the repeated rupturing of the follicles with the escape of the ova, and this puckering increases with years. With the termination of reproductive life and the cessation of menstruation, at the age of forty-five or thereby, the ovaries shrink until in the old woman they are small, shrivelled organs.

The surface of the ovary is bluish white in colour, and at the line of attachment to the mesovarium—the *hilum*—the whitish colour is replaced by the dull colour of the peritoneum. This line of attachment is usually called the *white line*.

The ovary is divided into three regions: (1) the hilum; (2) the medulla; (3) the cortex.

1. **HILUM.**—The small area which adjoins the mesovarium and which receives the twigs of the ovarian vessels, lymphatics and nerves which enter from the broad ligament. In addition it contains some scattered tubules—*rete ovarii*—the significance of which will emerge

later. The hilum possesses connective tissue and some unstriated muscle fibres continuous with the similar structures of the broad ligament.

2. MEDULLA.—This subtends the hilum as a semilunar area enclosed by the cortex. Its structure is similar to that of the hilum.

3. CORTEX OF THE OVARY.—This is the specialised functioning part of the ovary, for it contains the epithelial structures on which the activities of the ovary depend. It forms the main mass of the organ. It is composed of (a) connective tissue or stroma; (b) epithelial structures.

The *connective tissue stroma* consists of closely packed fibres which form a dense matrix for the vessels and Graafian follicles. Just under the covering epithelium it is thickened to form the *tunica albuginea*, a dense connective tissue layer which encloses the ovary and the presence of which gives the whitish colour to the surface of the organ.

Epithelial Structures.—These are :—(a) The *germinal epithelium* (Fig. 18)—a sheet of cubical cells one layer deep which covers the free surface of the ovary as far as the hilum, where transition into the endothelium of the peritoneum takes place. (b) The *interstitial gland of the ovary*—this consists of patches of epithelial cells scattered irregularly throughout the stroma which are inconspicuous in the human (in some of the lower animals—e.g. the rabbit and rat, a great part of the ovarian cortex is formed by these large cells). The significance of the interstitial cells is discussed in the next chapter (p. 60). (c) The *Graafian follicles*—formed round the ova which they enclose and nourish throughout their ovarian existence.

GRAAFIAN FOLLICLES.—When the ovary is laid open a number of rounded spaces of varying size filled with a clear fluid are visible to the naked eye. These are the ripening follicles. The smaller follicles are unrecognisable by the unaided eye. In the infant ovary there are about 100,000 follicles, but by puberty this number has diminished to about 30,000. The Graafian follicle is studied in four stages : (a) the primordial follicle ; (b) the maturing follicle ; (c) the mature follicle ; (d) the corpus luteum (Fig. 18).

Primordial Follicle.—This is the state of all follicles in the infant, and throughout life follicles in this stage can be seen. It is represented by a large, clear, central, more or less spherical cell—the *ovum*—surrounded by a layer of flat cells. These young follicles are congregated more towards the surface of the ovary.

Maturing Follicle.—Follicles may commence the process of ripening before puberty, but, with rare exceptions, the maturation phenomena are never complete till after puberty.

During maturation the ovum becomes larger, but the major changes affect the cells that surround it. These enlarge, and at the beginning there is present a single layer of cubical cells encircling the ovum.

Proliferation of these cells occurs until they are several layers deep—*membrana granulosa* cells (Fig. 18 (3)). At first the follicle is a solid mass of such cells enclosing the ovum. In time a collection of fluid gathers at one part of the mass—*liquor folliculi*—and as it increases in amount it displaces the ovum into an eccentric position in the follicle. The ovum then comes to be placed in a heap or disc of cells projecting into one side of the follicular cavity. This cellular disc is called the *discus proligerus* (Fig. 18 (4)).

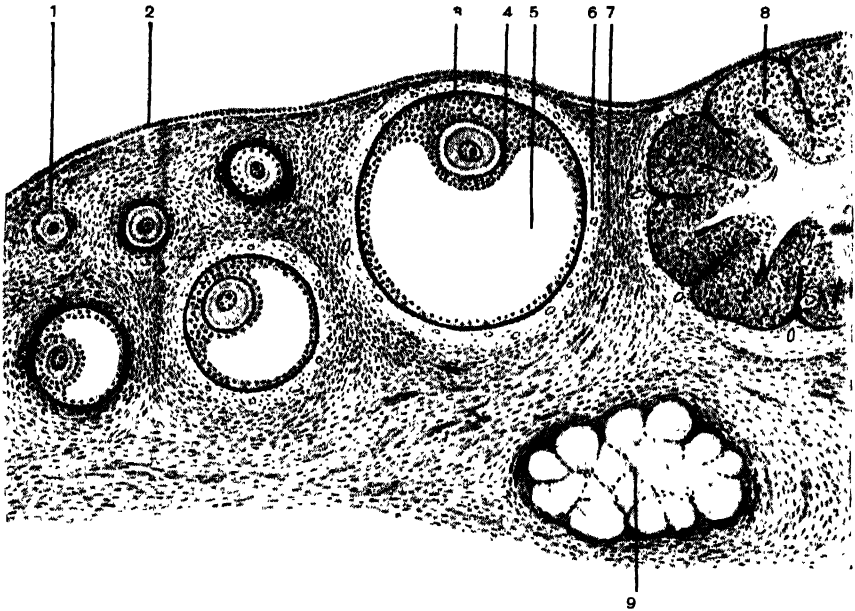


FIG. 18.—Section of Cortex of Ovary, showing graduated Stages of Maturation of the Graafian Follicle (diagrammatic).

- | | | |
|------------------------------------|---------------------------------------|---------------------|
| 1. Graafian Follicle (primordial). | 4. Discus Proligerus containing Ovum. | 7. Tunica Externa. |
| 2. Germinal Epithelium. | 5. Liquor Folliculi. | 8. Corpus Luteum. |
| 3. Membrana Granulosa. | 6. Tunica Interna. | 9. Corpus Albicans. |

There are changes in the adjacent stroma which accompany maturation ; these will be described under the next heading.

All stages of the maturation process are discernible in the ovary at the same time. Some of the follicles do not complete the process ; in them the ovum dies and the follicles shrink, becoming finally the *corpora fibrosa*. Follicles which do not mature completely are called *atresic follicles*. Some observers believe that the cells of the interstitial gland are derived from the epithelial cells of such atresic follicles.

Mature Follicle.—Complete maturation probably occurs only after puberty. As a follicle ripens it increases in size, due partly to the proliferation of the granulosa cells and partly to the increasing accumulation of liquor folliculi. A mature follicle is about $\frac{1}{8}$ inch (8 mm.) in

diameter. The enlarging follicle enters more deeply into the cortex and, in course of time, comes to project as a rounded swelling on the surface of the ovary.

The *ovum* during maturation increases in size until ultimately it has a diameter of about $\frac{1}{120}$ inch (0.2 mm.). The cytoplasm becomes granular and the nucleus occupies an eccentric position. The egg-cell now develops a cell-membrane. Enclosing the membrane is a clear space—the *perivitelline space*—surrounded by another clear space—the *zona pellucida*—which is bridged radially by a series of fine fibrils. Outside this the immediately adjacent granulosa cells are arranged radially to form the *zona radiata*. Before the ovum is ripe for fertilisation the extrusion of the polar bodies is carried out.

With these changes in the epithelial elements of the follicle there are occurring at the same time special changes in the surrounding stroma, which becomes marked off roughly into two layers—the tunica interna and the tunica externa. The *tunica interna*, or the layer of stroma next the follicle, becomes progressively more and more vascular, giving to the follicle the characteristic congestion that denotes maturation. In addition, the stroma-cells of this layer enlarge to form several layers of epithelium-like cells, with a large, clear body similar in size and structure to the cells of the membrana granulosa.

With the increase in size of the follicular cavity the follicle rises more and more towards the surface of the ovary, where it bulges in an area of deep congestion readily recognised by the naked eye as denoting the presence of a mature follicle. Strassman¹ has shown that during its early stage (up to 0.25 mm.) the growing follicle at first descends from the surface towards the hilus. Its subsequent rise towards the surface is associated with an eccentric growth of the theca interna and granulosa layers with the formation of a cone of tissue which always grows to the nearest point on the ovarian surface. This tropism is thus similar to that of the germinating seed in the soil. Strassman has found this process in all the mammalian orders which he studied—primates, carnivora, rodentia and ungulata. When it reaches the surface the follicle becomes thinned out, especially on the superficial aspect, until eventually it ruptures at a point called the *stigma*. Through this the ovum escapes into the peritoneal cavity, surrounded by some granulosa cells.

(CORPUS LUTEUM (Fig. 18 (8)).—After the escape of the ovum the follicle passes on to develop the corpus luteum. The stigma becomes closed with blood-clot. Within a few days after ovulation, if the follicle is cut across, it will be seen to be lined by a thin layer of greyish-yellow tissue—the luteinal tissue. Proliferation in the lutein layer is so active that the thin membrane becomes increased rapidly in thickness and in circumference. The result is that the yellow layer

¹ Strassman, E. O. *Amer. Journ. Obst. and Gyn.*, 1941, vol. xli., p. 363.



FIG. 19.—Section of Ovary, showing Two Primordial Follicles and Two Maturing Follicles at Different Stages. ($\times 100$.)

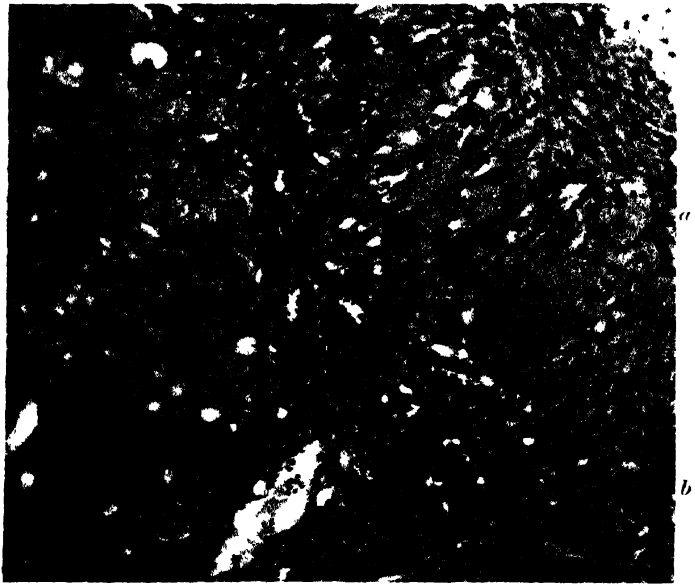


FIG. 19A.—Section through a Convolution of a Corpus Luteum, showing at Level (a) the Large Luteal Cells and (b) the Theca Lutein Cells. ($\times 100$.)

becomes more and more convoluted, and the cavity within is encroached upon and eventually is represented by thin, narrow spaces, filled with a blood coagulum dipping outwards between the luteinal convolutions. The average size of the fully formed corpus luteum is $\frac{1}{2}$ inch (1.2 cm.) to $\frac{3}{4}$ inch (1.7 cm.) in diameter.

Under the microscope the lutein layer is seen to consist of large, closely packed polyhedral cells containing a large, clear nucleus. These cells are very similar in their size and in the way they are set side by side in mosaic-like fashion to the decidual cells which form in the endometrium during pregnancy. The cell-body contains a lipoid

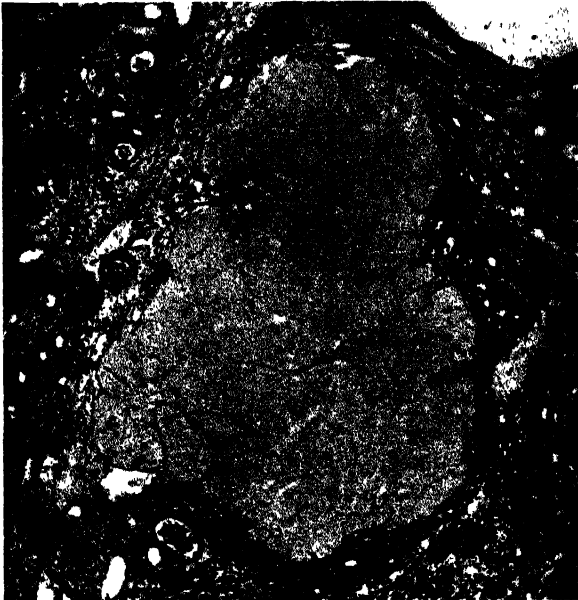


FIG. 19B.—Section of Ovary with Corpus Albicans. ($\times 50$.)

substance called *lutein*, and, to demonstrate this, special methods of preparation of the tissue are required.

In the past there has been considerable controversy in respect of the histological derivation of the corpus luteum cells, and at one time it was very generally believed that they arose from the theca interna. In this view the cells of the granulosa layer were believed to be thrown off at dehiscence or to undergo rapid degeneration thereafter. This conception has been steadily losing ground within recent years, and it may now be claimed that the investigations of Sabotta in lower animals and of Novak, Wilfred Shaw and Meyer in the human subject have established the view that the luteinal cells spring directly from the granulosa epithelium. The part played by the cells of the theca interna is not finally settled. By some observers they are believed to undergo retrogression, by others they are believed to increase in

numbers and size and to play a subsidiary rôle in the formation of the mature corpus.

The tissues surrounding the corpus luteum are hyperæmic, and capillary twigs from the distended vessels of the adjacent ovarian stroma pass into the corpus luteum and ramify between the luteinal cells. This special vascular arrangement is such as obtains in the ductless glands of the body, and its recognition first suggested the idea that the corpus luteum also belongs to this category. The point is more fully discussed in the next chapter, devoted to physiology.

It used to be taught that a free bleeding occurred into the cavity or follicle at the moment of rupture. It is now known that under normal conditions this is not so. It is, however, not uncommon to find such *blood cysts* of the corpus luteum in diseased and congested ovaries.

The corpus luteum, after reaching its maximum size about the twenty-second day, remains stationary until just before menstruation, when it begins to regress. The cells degenerate and by the end of menstruation this process is well marked. The disintegration of the cells is accompanied by the deposition throughout the corpus luteum of hyaline tissue, which increases in amount as the cells disappear. At the end of about nine months the corpus luteum is transformed into a *corpus albicans*.

Such is the *corpus luteum of menstruation*. If pregnancy occurs the corpus luteum enlarges progressively for some months, reaching its maximum after about three months. This is the *corpus luteum of pregnancy*, which is known to have a special function to subserve in presiding over the imbedding and development of the ovum in the uterus during the first months of pregnancy (p. 58).

PAROVARIIUM

The parovarium or epoöphoron (Fig. 11) is a vestigial structure in the female derived from the Wolffian body and duct and corresponding in development to the epididymis and vas deferens of the male. It lies in the upper part of the broad ligament and its general structure can be readily seen, if the broad ligament be put on the stretch, between tube and ovary, and a good light be allowed to pass through it. It is then seen to consist of ten or twelve vertical tubules, which pass upwards close to one another from the hilum of the ovary to unite with a single transverse duct—the *duct of Gärtner*. This duct is blind at its outer end, where it often splits into a number of tubules which sometimes dangle free from the broad ligament and may become transformed into small cysts. The inner end of Gärtner's duct turns downwards along the sides of the uterus, where it usually disappears. In rare instances, however, it may be traced along the anterior vaginal wall as far as the vulva (*vide* Figs. 359 and 407).

UTERINE LIGAMENTS

The ligaments of the uterus are : (1) broad ; (2) round ; (3) utero-sacral ; (4) transverse cervical.

BROAD LIGAMENTS (Figs. 9, 11).—These are loose double folds of peritoneum, which extend outwards from the sides of the uterus to the side wall of the pelvis on each side. At the pelvic wall the ligament is attached along a line which passes obliquely downwards and backwards from the level of the external iliac vessels. This oblique line of attachment on each side confirms the forward tilt which the uterus possesses. The broad ligaments embrace the body of the uterus, giving to it its peritoneal covering, and structurally the two ligaments may be considered as one double fold of peritoneum, which extends across the pelvis from side to side and which separates at its middle to accommodate the womb.

The broad ligaments enclose some connective tissue and unstriated muscle, in addition to the structures which will be described presently.

The upper margin of the broad ligament is free and contains the Fallopian tube, and below this the ovarian vessels, nerves and lymphatics which extend into it from the side wall of the pelvis. At a lower level, in a situation lying between the tube and the mesovarium, the parovarium is placed. The tube passes backwards, leaves the broad ligament, and opens into the peritoneal cavity. From this point the broad ligament is named the *infundibulo-pelvic ligament*, and contains the ovarian vessels.

The ovary is slung from the posterior layer of the broad ligament by the *mesovarium*, and from the inner pole of the ovary the *ovarian ligament* passes along the inner and upper edge of the broad ligament to reach the posterior aspect of the cornu of the uterus below the tubal insertion. From the cornu of the uterus in front at a similar level the round ligament passes obliquely forwards under the anterior layer of the broad ligament to the internal abdominal ring.

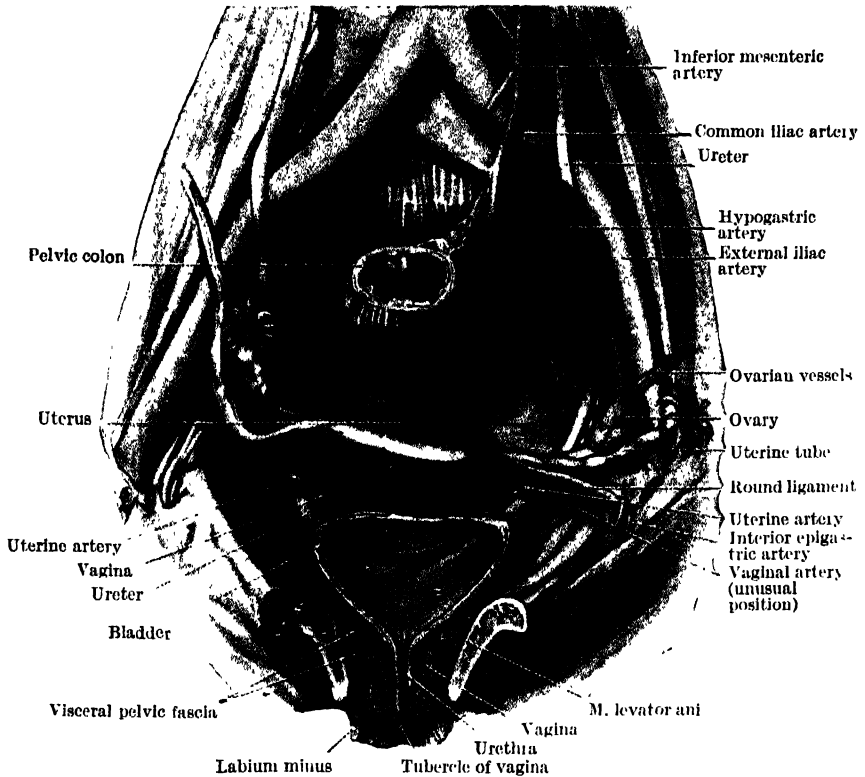
Along the inner margin of the broad ligament at the side of the uterus lie the tortuous vessels formed by the descending branches of the ovarian vessels, which anastomose with the ascending branches of the uterine vessels (Fig. 23).

The anterior layer of the broad ligament is shorter from above downwards than the posterior, which dips deeply into the hinder part of the pelvis, where it becomes continuous with the peritoneum covering the floor of the pararectal fossa (Fig. 20).

ROUND LIGAMENTS (Figs. 10, 20).—These are two thin fibromuscular cords which arise from the anterior aspect of the uterine cornu and pass at first forwards and downwards and outwards under the peritoneum of the broad ligament. They then sweep upwards and forwards and disappear within the internal abdominal ring. After traversing the inguinal canal they split up into thin subdivisions

that obtain attachment to the subcutaneous tissues of the anterior abdominal wall and labium majus. Their thickness varies in different women, and this is a point of some moment in connection with certain surgical operations in which they are utilised.

UTERO-SACRAL LIGAMENTS (Fig. 10).—These are two firm fibromuscular cords which extend backwards from the posterior aspect of



With permission from Cunningham's "Manual of Practical Anatomy."

FIG. 20.—Dissection of the Pelvis of a Multiparous Female, showing the relations of the Bladder to the Uterus and Vagina, the relations of the Vagina to the Urethra and the Broad Ligaments, and the relations of the Ureters to the Broad Ligaments and Vagina.

the sides of the isthmus of the uterus to obtain attachment to the anterior surface of the lower end of the sacrum. Over them the peritoneum is lifted in the form of two ridges enclosing between them the opening of the pouch of Douglas. On the outer sides of the ligaments the *pararectal fossæ* are situated.

TRANSVERSE CERVICAL LIGAMENTS.—These are not special bands like the round and utero-sacral ligaments, but consist merely of the firm fibromuscular tissues that ensheath the uterine vessels as they pass to the cervix and upper end of the vagina from the side walls of the pelvis. They play an important part in tethering the womb in its position (*vide* Gynæcological Section, pp. 838, 840).

PUBO-VESICAL LIGAMENTS.—Though not directly fixed to the uterus, these ligaments play an important part in maintaining the statics of the pelvic viscera and indirectly the position of the uterus. They consist of two firm bands of connective tissue belonging to the visceral layer of the pelvic fascia; they pass backwards from the posterior surface of the pubes to the base of the bladder, which they assist in supporting.

The special ligaments mentioned play parts of varying importance in supporting the uterus in its normal position, but they must not be considered as consisting always of tight bands that firmly fix the womb. During an abdominal operation the broad, round and utero-sacral ligaments are seen to be lax structures. Moreover, the womb can be drawn down into the vagina or upwards into the abdomen for a considerable distance before these ligaments are put on the stretch.

The broad and round ligaments merely act as stays, preventing excessive movement of the uterus and appendages. The transverse cervical and utero-sacral ligaments, however, have an important supporting influence. Of all the uterine ligaments the transverse cervical play the most prominent part in maintaining the statics of the womb.

It is probably correct to consider the uterine ligaments as acting by preventing excessive movements of the uterus. The admixture of muscle tissue they contain will, in addition, bring into play a tonic resiliency which will help to steady the uterus, though unable to resist gross strains. As we shall see later, additional supports are provided by the musculo-fibrous structures of the pelvic floor in general.

It is hardly necessary to mention that the uterine ligaments serve as "mesenteries" by carrying the vascular supply to the womb.

PELVIC FLOOR

The pelvic floor is the curtain of soft parts that closes over the outlet of the bony pelvis. It is constituted of all the structures from the peritoneum on the inside to the skin and mucous membrane on the outside. These are peritoneum, pelvic fascia with vessels, lymphatics and nerves, levator ani and coccygeus muscles, and skin and mucous membrane. The pelvic viscera—bladder, uterus and rectum—are moulded on the upper aspect of the pelvic floor, and they channel it by means of their respective canals—urethra, vagina and anal canal—to reach the outer surface. In reality these visceral structures form a component part of the pelvic floor. The external organs of generation are built on to the outer aspect of the pelvic floor.

PERITONEUM OF THE PELVIS.—The pelvic peritoneum is continued down into the pelvis from the abdomen. As seen in a mesial sagittal section, its course can be traced from before backwards (Fig. 10).

Leaving the anterior pelvic wall at the back of the symphysis pubis, it arches over the fundus of the bladder to the isthmus of the uterus, from which it is reflected upwards to enclose the body of the uterus. The shallow pouch between the bladder and uterus is called the *utero-vesical pouch*. The peritoneum is laid loosely over the bladder, an arrangement which allows of ready distension of this organ.

After enclosing the body of the uterus in front and behind the peritoneum is continued downwards over the posterior surface of the supravaginal cervix and uppermost part of posterior vaginal wall. From this it is carried on to the anterior rectal wall, the deep pouch between vagina and rectum being named the *pouch of Douglas*. In its lower part it covers only the anterior wall of the rectum, whilst higher up it encloses the lateral walls as well. From the rectum it is seen to pass directly on to the front of the sacrum and, at the level of the promontory, it passes into the peritoneum of the posterior abdominal wall.

As viewed from above the peritoneum is seen to extend from side to side of the pelvis. The fold formed by the broad ligaments on each side and containing the uterus acts as a transverse septum, dividing the pelvic cavity roughly into two compartments, one in front and one behind the uterus. In the anterior compartment the peritoneum extends from front to back, as has been described in a preceding paragraph. From side to side it extends as a shallow pouch rising in the middle over the bladder. Under this sheet on each side the round ligaments course obliquely forwards and outwards from the uterine cornua to the internal abdominal rings. On each side of the bladder the shallow pouch is sometimes called the *paravesical pouch*. Behind the bladder, between it and the uterus, is the shallow *utero-vesical pouch*.

The position and relation of the round and broad ligaments have been described under the heading of Uterine Ligaments.

Behind the broad ligaments lies the posterior peritoneal compartment. Passing inwards from the side wall of the pelvis on each side the peritoneal sheet covers the utero-sacral ligament and just within this dips down abruptly to line the deep *pouch of Douglas*. The utero-sacral ligaments thus divide the posterior compartment into a mesial, deep fossa—*pouch of Douglas*—and two lateral, shallow fossæ—*pararectal fossæ*. Behind, the peritoneum forms an incomplete mesentery for the rectum.

PELVIC FASCIA.—This is the continuation into the pelvis of the extraperitoneal fascia of the abdomen. Just below the pelvic brim (white line) it splits into two layers—parietal and visceral. The *parietal layer* continues downwards as a sheet clothing the inner walls of the pelvis, and through the obturator and the sacro-sciatic foramina it is continuous with the fasciæ of the thigh and buttock. It clothes the muscles laid against the inner pelvic wall, and at the margins of the

pelvic outlet it becomes attached to the bones. Where it bridges across the arch of the pubis it forms the upper or posterior layer of the triangular ligament.

The *visceral layer* extends inwards all round from the pelvic walls just below the brim in the form of a basin. It clothes the upper surfaces of the levatores ani and coccygei muscles and sends sheaths round and between the viscera, which thus come to be virtually imbedded in its substance. Thus in front it covers the bladder, and as it passes from the posterior surface of the symphysis to the base of the bladder it is thickened into two strong bands—the *pubo-vesical ligaments*. Behind the bladder it encircles the vagina and cervix. In the body of the uterus there is no fibrous capsule, for the peritoneum is laid directly against the muscular wall. The visceral fascia is specially

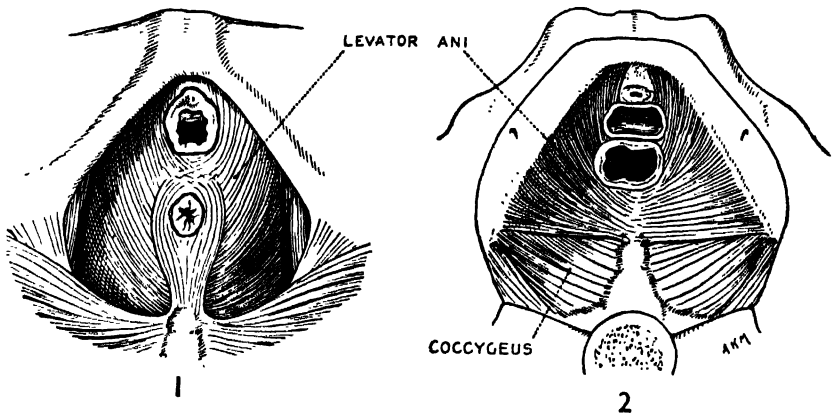


FIG. 21—Pelvic Floor or Diaphragm.

1. From below (Perineal Muscles removed). 2. From above (Superstructures removed).

abundant round the front and sides of the cervix, where it goes by the name of the *parametrium*. On each side it passes to the side wall of the pelvis, and is specially evident as a mass of fibrous tissue mingled with some unstriped muscle which forms the bed for the uterine vessels—the *transverse cervical ligaments* (p. 32).

LEVATOR ANI AND COCCYGEUS.—These two muscles on each side form the main muscular constituent of the pelvic floor (Fig. 21).

The levator ani consists of two muscles—the *pubo-coccygeus* and the *ilio-coccygeus*. The *pubo-coccygeus* arises from the back of the body of the pubes. Its fibres pass backwards and downwards and are inserted, a few into the central point of the perineum, and the majority into the anal canal between the internal and external sphincters and the angle between the posterior wall of the rectum and the upper end of the anal canal. Here they unite with their fellows of the opposite side and form a strong muscular collar round the gut. The *ilio-coccygeus* arises from the angle between the visceral and parietal layers of the

pelvic fascia (white line) and from the ischial spine. The fibres of this muscle are inserted partly into the angle between the posterior rectal wall and the anal canal and partly into the median ano-coccygeal raphé and side of the lower part of the coccyx.

Coccygeus (or Ischio-Coccygeus).—This muscle arises from the ischial spine and the adjacent pelvic fascia, and, expanding fan-wise, it is inserted into the side of the last sacral vertebra and the anterior surface of the upper part of the coccyx. It thus continues backwards the pelvic sheet of muscle formed in front of it by the levator ani muscle.

The levatores ani and the coccygei, it will be seen, form a broad muscular sheet stretching across the pelvic cavity; they form the main muscular constituent of the pelvic floor and fortified by the pelvic

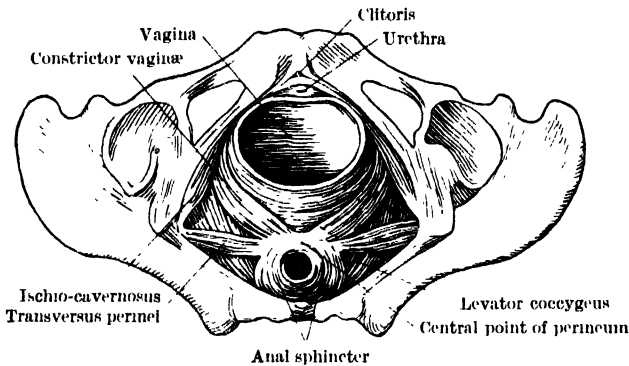


FIG. 22.—Dissection of Pelvic Floor when fully distended during Parturition.

fascia support the intra-abdominal pressure transmitted through the pelvis. In addition, the levatores ani, by virtue of their points of insertion round the anal canal and rectum, take part in the act of defæcation.

PERINEAL MUSCLES.—In obstetrics the structure referred to as the perineum or perineal body is the triangular mass of fibromuscular tissue between the vagina and the lowermost portion of rectum. The true anatomical perineum is a more extended area, which is divided into an anterior and a posterior section by the vaginal canal. The muscles include the sphincter ani externus, the transversus perinei, the bulbo cavernosus and the ischio-cavernosus. All except the cavernosus have one insertion in the central part of the perineal body. They contract during intercourse and defæcation; are greatly stretched, and may be torn during delivery.

In the later stages of labour, when the presenting part is driven on to the pelvic floor, the latter gradually becomes more and more stretched, until as the presenting part escapes from the vagina the appearance on dissection is as shown in the illustration (Fig. 22).

URETHRA, BLADDER AND URETER

URETHRA.—The urethra in the female is $1\frac{1}{2}$ inches (3·7 cm.) long. After leaving the base of the bladder it passes downwards and forwards to the *external urethral meatus*, pursuing a course which is slightly curved forwards. On the way it pierces the two layers of the triangular ligament, and in the interval between them it is surrounded by the *sphincter urethræ membranaceæ*. In its lower part it is intimately incorporated with the vaginal wall; above this it can be stripped readily from the vagina (Fig. 9).

The urethra has a muscular, a submucous and a mucous coat. The muscular wall is composed of an outer circular and an inner longitudinal layer. The submucous coat consists of loose fibrous and elastic fibres. The mucous membrane is thrown into longitudinal folds. It is lined by transitional epithelium near the bladder and by squamous epithelium near the meatus. The urethra possesses numerous glands, especially near the meatus. Two comparatively large ducts, into which a probe can often be passed, open one on each side of the posterior wall of the urethra just within the meatus. These are known as *Skene's ducts*. The urethra of the female is dilatable, and for purposes of examination can be expanded to a diameter of $\frac{1}{2}$ inch (12 mm.) without damage.

BLADDER (Figs. 9, 10).—The bladder in the foetus and infant is an abdominal organ. In the adult, however, it is normally entirely within the pelvis. It lies between the pubes and the uterus. With distension of the bladder the uterus is lifted upwards more into the erect position. The normal capacity of the bladder is about 12 to 14 ounces. When fully distended, even within normal limits, it forms an elastic swelling of a flat ovoid shape felt distinctly above the symphysis pubis.

The upper wall and sides of the bladder are covered by peritoneum, which, behind, is reflected on to the uterus at the level of the isthmus. The shallow peritoneal fossa between bladder and uterus is the *utero-vesical pouch*. In front, the bladder is related to the back of the pubes, from which it is separated by loose tissue. Behind, it lies against the *supravaginal cervix* and upper part of the anterior vaginal wall. With each of these it is only loosely incorporated. Below, the bladder is supported by the visceral layer of the pelvic fascia and by the *levator ani muscles*.

URETER (Figs. 9, 20).—The pelvic portion of the ureter has an important relation to the pelvic organs, and its exact position must be kept constantly in mind by the gynæcological surgeon. The ureter enters the pelvis by crossing the brim at the level of the lower end of the common iliac or the upper end of the external iliac artery. It descends along the front of the internal iliac artery to the level of the ischial spine. It then turns inwards and, coursing forwards and

downwards, it passes beneath the base of the broad ligament. At this point it is crossed by the uterine vessels (Fig. 23). It now crosses the lateral fornix and upper part of the front wall of the vagina to reach the side of the bladder about 2 inches (5 cm.) from its fellow of the opposite side. As the ureter approaches the bladder its oblique course brings it nearer and nearer to the supravaginal cervix, and just before it reaches the bladder it is only half an inch (1.2 cm.) from the cervix.

PELVIC BLOOD-VESSELS

The internal pelvic organs in the female are supplied by the ovarian, uterine and vaginal arteries. The vulvar structures are supplied by the internal pubic artery.

The *ovarian artery* rises on each side from the abdominal aorta. It enters the pelvis by crossing the upper part of the external iliac artery and passes between the layers of the outer end of the broad ligament,

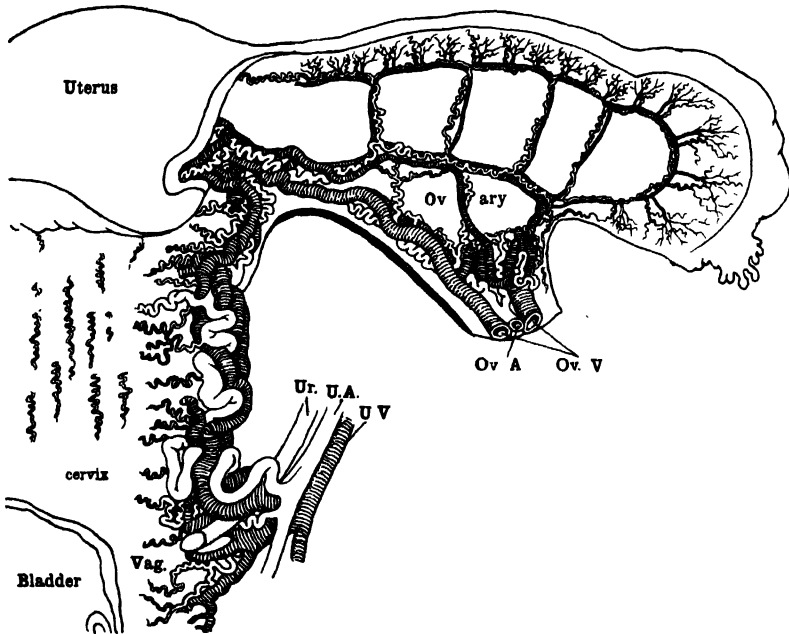


FIG. 23.—Uterine and Ovarian Plexus of Vessels in Broad Ligament (after Kelly).

at this point called the infundibulo-pelvic ligament. It runs in the upper part of the broad ligament to the uterine cornu, where it anastomoses with the terminal branch of the uterine artery. On the way it supplies the ovary and the Fallopian tube. The accompanying veins form the *pampiniform plexus*, which is specially developed during pregnancy. From this plexus two ovarian veins emerge, and these later fuse to form a single ovarian vein. But, while the right vein passes into the vena cava, the left passes into the left renal vein. This

is an important anatomical feature and explains why the pampiniform plexus of the left broad ligament is more liable to become distended than that of the right. In some instances the vague left-sided pain complained of by many women may be due to congestion of the left broad ligament.

The *uterine artery* arises from the anterior branch of the internal iliac artery. It runs downwards in front of the ureter, and then, turning inwards, it passes along the lower border of the broad ligament, crossing above the lower end of the ureter (Figs. 9, 23). It reaches the uterus at the level of the isthmus and the main trunk passes upwards in a tortuous course along the side of the uterus to anastomose at the uterine cornu with the terminal branch of the ovarian artery. All along its course the uterine artery sends off branches at right angles which pass, some in front, some behind, the uterus and anastomose with their fellows of the opposite side. The uterus is thus encircled with arterial branches, and these send in twigs to supply the uterine walls. One of these arches encircles the cervix. It is of comparatively large size and is called the *circular artery of the cervix*.

Branches from the uterine artery descend to anastomose with the vaginal artery. The *uterine veins* accompany the artery.

The *vaginal artery* springs from the anterior division of the internal iliac below the uterine artery. Sometimes there are several arteries on each side. They pass mesially to the side of the upper part of the vagina, sending branches to supply the vagina and also some twigs upwards to anastomose with the uterine artery.

The *azygos vaginae arteries*, when present, run along the middle of the anterior and posterior vaginal walls. They are derived from the circular artery of the cervix and the vaginal arteries. The *vaginal veins* form a plexus round the vagina.

The *internal pubic artery* supplies the vulva and perineum. The accompanying veins pass into the inferior hæmorrhoidal and inferior vesical plexuses. During pregnancy these veins in the labia often become distended in a varicose fashion.

LYMPHATICS

From the vulva and lower end of the vagina the lymph vessels pass to the *superficial inguinal and sacral glands*. From the upper and middle parts of the vagina and from the cervix the lymphatic vessels pass to the *internal and external iliac glands* lying along the corresponding vessels, and to the *sacral glands*. From the uterine body they pass to the internal and external iliac glands. The lymphatic vessels from the upper end of the uterus accompany the lymphatics from the ovary and tube and pass into the *lumbar glands* lying upon the lower end of the aorta and the inferior vena cava. A few lymph vessels from the upper end of the uterus pass forwards along the round ligament to end in the *superficial inguinal glands*.

NERVES OF UTERUS, OVARY, BLADDER, AND FALLOPIAN TUBE

NERVES OF UTERUS.—These are derived from the pelvic plexuses, two large sheets of nerve tissue, including filaments and ganglionic cells, which lie one on each side of the rectum. These plexuses are called by various names (Frankenhauser's plexus, lateral cervical

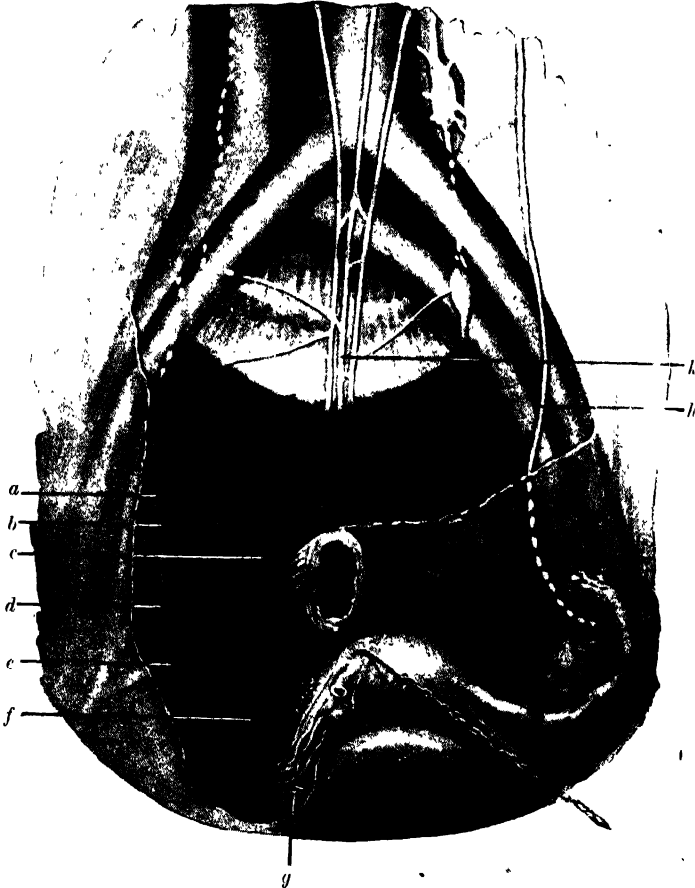


FIG. 24.—Nerve Plexuses of Pelvis.

a, Lateral sympathetic chain. *b*, Second sacral nerve. *c*, Right interior hypogastric plexus (posterior part). *d* and *e*, Third and fourth sacral nerves. *f*, Inferior hypogastric plexus (anterior part). *g*, Nerves to bladder. *h*, Left ovarian nerve. *k*, "Presacral" nerve.

plexus, cervical ganglion, etc.) and are composed on each side of the downward extension of the abdominal sympathetic chain (Fig. 24), by means of which they are linked with the solar and mesenteric plexuses. The two lateral systems of abdominal sympathetic nerves as they extend downwards to the pelvis converge, and in front of the fourth

and fifth lumbar vertebræ form the superior hypogastric plexus. This consists usually of two or three parallel and intercommunicating nerves. Occasionally it consists of a single nerve—the so-called *presacral nerve*, a term which is unfortunate, as the plexus lies in front of the two lower lumbar vertebra, and “*prelumbar*” nerve would therefore be more appropriate. Below the promontory of the sacrum the hypogastric plexus separates into two divisions—the right and left inferior hypogastric plexus—each of which receives communications from the anterior branches of the sacral nerves (second and third, third and fourth, or second, third and fourth) and a few twigs from the lateral sacral ganglia of the sympathetic. Passing onwards to the side of the rectum the plexus on each side becomes the main pelvic plexus. With a few exceptions all the pelvic viscera are supplied by this plexus. The nerves of the uterus pass forward at first in company with the nerves to bladder and vagina. Leaving these the uterine nerves pass as a thick bundle along the utero-sacral ligament to the cervix, whence they are distributed to the different parts of the organ.

MOTOR FUNCTIONS OF UTERUS.—The relative parts which the sympathetic and the parasympathetic nerves play in the control of the motor functions of the uterus are not clearly understood. It is known from experiments on lower animals that uterine contractions can occur and that parturition can be effected spontaneously after division of all the uterine nerves. Further, in women parturition can take place spontaneously after accident or disease causing destruction of the lower end of the spinal cord. Cotte has found no evidence of interference with delivery in thirty women who became pregnant after division of the “*presacral*” nerve. These data suggest that the contractility of the uterine muscle is dependent upon an intrinsic mechanism. That the sympathetic or parasympathetic nerves or both are concerned with the tone of the uterine muscle is suggested by the effects noted in the case of Cæsarean section carried out under spinal anaesthesia. It is well known that under these conditions the uterine body when exposed is found to be firm. After incision the muscle edges contract to produce a marked natural hæmostasis, as contrasted with the free bleeding experienced in an operation carried out under general anaesthesia. This has been explained as due to the withdrawal of the inhibitory influence of the spinal cord and to the operation of the motor influence of the sympathetic nerves.

MOTOR FUNCTIONS OF BLADDER.—The work of Learmonth and others indicates that the sympathetic fibres (*presacral nerve*), are inhibitory to the detrusor muscle of the bladder, which is responsible for expulsion, and motor to the internal sphincter. The parasympathetic (*sacral autonomic, nervi erigentes*), on the other hand, are motor to the detrusor and inhibitory to the internal sphincter muscle. Learmonth found that, when the bladder was under observation with the cystoscope, stimulation of the *presacral nerve* in a patient under spinal anaesthesia

caused contraction of the ureteric orifices, increased tonus of the trigon, contraction of the internal sphincter and constriction of the vessels of the trigon, the opposite results being produced by section of the nerve. Division of the presacral nerve for intrinsic dysmenorrhœa may be followed by frequency of micturition, which usually disappears within a short period. One of the authors (Young) has noted complete incontinence of urine in a patient after presacral neurectomy; the condition lasted for two months, after which gradual recovery took place.

AFFERENT NERVES OF UTERUS AND BLÄDDER.—Division of the presacral nerve (p. 40) is frequently used with a considerable degree of success in cases of severe intrinsic dysmenorrhœa. From this it would seem that the afferent nerves from the uterus pass along the sympathetic tracks in the hypogastric plexuses. That the vesical afferent supply pursues a similar course is suggested by the relief sometimes obtained in cases of intractable bladder irritability after division of the presacral nerve. The site at which the afferent nerves of the uterus reach the spinal cord is not clearly defined. Clinical observations suggest that they enter through the posterior roots of the tenth, eleventh and twelfth thoracic nerves, the first lumbar and the second to the fourth sacral nerves.

NERVES OF OVARY AND FALLOPIAN TUBE.—The *ovary* is supplied from a plexus which is continuous at its upper end with the renal plexus and which accompanies the ovarian artery (Fig. 24). Some fibres join the ovarian plexus from the aortic plexus. The afferent nerves of the ovary are believed to reach the spinal cord through the posterior roots of the tenth thoracic nerve. The *Fallopian tube* is supplied by the ovarian plexus, and also from the branches of the inferior hypogastric plexus which supply the uterus. The afferent fibres of the tube are believed to reach the spinal cord by the posterior roots of the eleventh and twelfth thoracic and the first lumbar nerves.

NERVES OF THE EXTERNAL GENITAL ORGANS.—These come from the ilio-inguinal nerve from the lumbar plexus, the pubic nerve from the sacral plexus and the inferior pudendal nerve.

CHAPTER III

PHYSIOLOGY OF THE REPRODUCTIVE SYSTEM

THE organs of the reproductive system differ from the other organs of the body, in that they do not reach maturity until the second decade of life, and cease to function in women at an age before senile changes in the other body tissues are usually observed. Again, in addition to those functions which are essentially sexual in character, and associated with the propagation of the species, the ovary, as one of the group of ductless glands, plays a very important part in the control which is exercised over all the body processes. One phase of this endocrinous function of the ovary is most active while skeletal growth is still progressing, before sexual life has commenced ; a later phase assists in the control of the sexual functions, and in maintaining the integrity of the other body processes.

There are two processes which may be described as sexual and which occur regularly in all normal women throughout some thirty or more years of their lives. These are *ovulation* and *menstruation*, the former providing for the systematic growth and periodic shedding of ripe ova from the ovary ; the latter resulting in the periodic discharge of blood, or, more correctly, blood and mucus, from the uterus. The physiological consideration of pregnancy, which may occur at any stage of active reproductive life, is dealt with in Chapter VII. Ovulation is phylogenetically an older and more important process than menstruation, but, as the latter plays such a prominent part in the ordinary life of women, it is dealt with first.

PUBERTY

The sexual life of woman is usually reckoned from the appearance of menstruation until its disappearance—ovulation is a much more difficult process to observe. The first establishment of the menstrual function is taken to represent the attainment of sexual maturity, and is known as puberty.

Puberty occurs in different individuals at different ages. In this country the average age is about 14½ years—with limits extending from 10 to 18 years. A careful study of such ages in a large number of women of different races, countries, and climates, has shown that the occurrence of puberty depends on racial rather than climatic factors—in Hungary, Jewesses start at 13, while the Slavs do not start until about 16.

Within the race there are further variations associated with nutrition, environment and education. Over-nutrition, luxurious habits of life, and high tension in mental development and effort conduce to early puberty.

Outside the general age limits stated above, puberty should be regarded as either precocious or delayed. *Precocious puberty* may result from over-activity in one or both ovaries. To this category belongs the type of case recorded by Lucas, where the phenomenon was associated with a tumour of the ovary, and where the removal of the tumour was followed by the disappearance of the symptoms of puberty. In other cases the cause may be some lesion of the suprarenal, anterior lobe of the pituitary, or pineal gland. The condition of *delayed puberty* may be due to defective functioning of either the reproductive organs themselves (ovaries and uterus) or of some member of the endocrinous system such as the pituitary or thyroid gland.

CLINICAL CHARACTERISTICS OF PUBERTY.—Puberty is associated with changes in the physical and psychical development of the girl. The body begins to assume the outline characteristic of the female sex—the hips become more rounded, the breasts fuller and more prominent, while the nipples also become larger. The organs of reproduction complete their development internally; the body of the uterus grows more quickly than the cervix, and becomes much more rounded and thickened, very soon forming more than half the bulk of the whole organ (Fig. 13). The bony pelvis has by now assumed the characteristic female shape. Externally the labia majora, hitherto inconspicuous, increase rapidly in size by the deposit of adipose tissue, and very soon almost conceal the labia minora. Hair appears on the pubes and in the axillæ. The thyroid gland may show marked enlargement with a temporary tachycardia, and unfortunately this may form the starting-point of a permanent goitre.

Mentally, there may be little change. An access of shyness, owing to the realisation of the possession of the emblems of sex, with a general increase in sensitiveness, may be the only signs. It is difficult to estimate how far these are the result of custom and education.

MENSTRUATION

The frequency, duration and amount of the menstrual periods vary not only with the individual, but also with different stages in the life of the individual. Some women begin reproductive life with scanty periods, and afterwards find their periods more profuse than normal; others begin with painful periods and find that the pain disappears after a few years, while others, less fortunate, begin with painless periods and acquire a profound dysmenorrhœa later. Such changes may occur without any gross pathological lesion to account for these variations in function.

Typically, the discharge lasts from three to six days, and the first days of consecutive periods are separated by an interval of twenty-eight days. This interval, however, may be in some women as short as twenty-one, and in others as long as thirty-five days. Each woman has her own menstrual type; and, while in the majority the cycle occupies twenty-eight days, variations within the above-mentioned limits may be regarded as normal. Menstruation in this form is peculiar to the human race and to the higher primates, but less highly developed forms of cyclical sexual changes are found in lower animals.

Throughout the whole group of mammals there is usually a definite breeding season associated with the appearance of "rut," œstrus, or sexual desire on the part of the animals. At the same time there are changes in the reproductive organs which have been most carefully studied in various species by Heape and others. With the approach of œstrus, the histological appearances of the quiescent or *anœstrus* phase are lost—there is increased vascularity with hypertrophy of the endometrium, giving the appearances of the *pro-œstrus* phase. In some mammals, such as the bitch, the congestion may be so great that the endometrium gives way in places and allows the escape of blood from the uterus. Along with the changes in the endometrium, the vaginal mucous membrane proliferates, and "cornified cells" are shed into the lumen. Then comes the *phase of œstrus*, which, in the majority of mammals, is the period at which coitus occurs, and which may last from a few hours as in the sheep, to several days as in the bitch. The uterine glands secrete very actively, and the "cornified cells" in the vagina are removed by an invasion of leucocytes.

Normally, œstrus is followed by pregnancy; but should fertilisation not occur, certain further changes take place before the endometrium returns to the resting phase. The uterus becomes still more vascular, and all the tissues of the endometrium, epithelial and stromal, hypertrophy. The changes are exactly comparable to those which would have taken place had fertilisation occurred, but this special phase is of short duration. At the end of a few days growth gives place to necrosis, and in a few mammals—*e.g.* certain types of monkeys and the cow—there is actual uterine hæmorrhage; in the monkey, shreds of endometrium are found in the hæmorrhagic discharge. This degenerative change is followed by reparative processes, which restore the endometrium to the appearance of the quiescent phase. This peculiar phenomenon in the lower mammals, when fertilisation does not occur, has been described as *pseudo-pregnancy* and has a most important relationship to the menstrual phenomena in women. We see that there are two distinct phases of the cycle in mammals at which vaginal hæmorrhage occurs, *viz.*, in the *pro-œstrum* due to vascularity, and at the end of *pseudo-pregnancy*, due to necrosis of the endometrium.

Mammals are described as *monœstrus* where the sexual season is associated with only one complete œstrus cycle, and as *polyœstrus* where

there is a recurrence of short œstrus cycles throughout the sexual season. It has been found that certain mammals which are monœstrus in the wild state may become polyœstrus when domesticated, under easier conditions of life and nutrition.

In the human race traces of a breeding season can be found in certain aboriginal tribes: among the Esquimaux, menstruation may remain in abeyance during the winter months. Civilisation may have had some influence in bringing about the perennial menstrual cycle, which is characteristic of almost the whole human species.

The Menstrual Cycle.—While certain analogies can be drawn between the œstrus changes in mammals and the menstrual phenomena

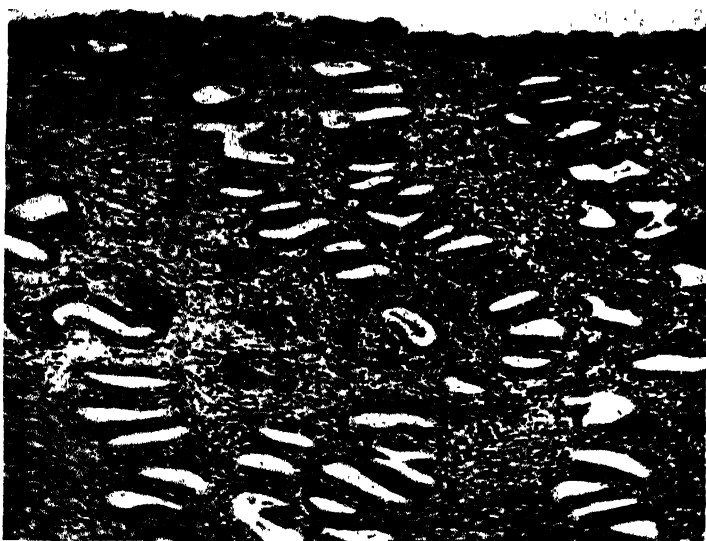


FIG. 25.—Intermenstrual or Proliferative Phase. Endometrium under the influence of œstrone at the tenth day of the menstrual cycle (H. L. Sheehan).

in women, the two processes are not quite comparable. The human endometrium is in a state of almost continuous change throughout the whole twenty-eight days which comprise the normal sexual cycle, but for purposes of description, a division may be made into the following phases:—

- (1) Intermenstrual or Proliferative Phase, lasting about ten days.
- (2) Premenstrual or Secretory Phase, lasting about ten days.
- (3) Menstrual or Destructive Phase, lasting about five days.
- (4) Postmenstrual or Regenerative Phase, lasting about four days.

THE INTERMENSTRUAL OR PROLIFERATIVE PHASE.—This phase begins about four days after the cessation of the menstrual flow, and shows the endometrium in its simplest form (*vide* Anatomy, p. 18). From this simple form proliferative changes take place, and during this phase

many mitotic figures are seen in the epithelial and stroma cells. The glands increase in length and become more tortuous—the lining epithelium becomes more columnar with centrally placed nuclei. The stroma cells show oedematous changes, with separation of the individual cells and formation of intercellular lymph spaces. Progressive vascular changes occur—the capillaries in the superficial layers become dilated. This vascularisation may be so intense as to cause the oozing of blood into the uterine cavity and give rise to one form of intermenstrual bleeding.

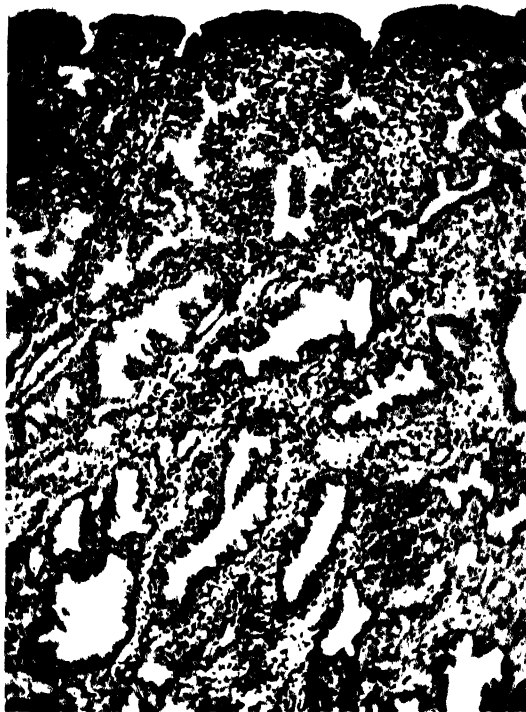


FIG. 26.—Premenstrual or Secretory Phase. Endometrium under the influence of progesterone—at the twenty-fifth day of the menstrual cycle (H. L. Sheehan).

During this phase one Graafian follicle is approaching full development, and just before the end of the phase discharges a mature ovum. The proliferative changes in the endometrium are associated with the secretion of the follicular or oestrogenic hormone (p. 57).

THE PREMENSTRUAL OR SECRETORY PHASE.—The endometrial changes continue to their culmination. The proliferation of the preceding phase gives place to hypertrophy and secretion—mitotic figures are no longer seen. The inner surface of the uterus appears congested and red, and beads of mucoid secretion appear on the surface. By the end of the phase the total thickness of the endometrium has increased to 6 or 7 mm.

The glands increase in size and length, their outlines still more tortuous. The lumina become distended with secretion in their middle zone, and the adjacent glands come to lie more closely together. Those changes give a characteristic picture on section—the spiral form of the glands gives a dentate appearance to the outline of an individual gland traced through one section, and the diminution in the concentration of stroma where the glands are most distended gives a spongy appearance to the whole zone (Fig. 26).

The epithelial cells develop spherical translucent areas between the nucleus and the basement membrane. Later, the nucleus sinks towards the base of the cell as the globules of secretion move towards the free surface and eventually escape into the gland lumen.

The stroma cells now form a dense area just under the surface of the epithelium and surrounding the ducts of the glands. The individual cells become more swollen from the continued imbibition by the cell protoplasm of fluid from the circulating blood: the nuclei stain less deeply. These cells are developing towards the type of decidual cell so characteristic of the endometrium in pregnancy.

The vascularization of the endometrium continues, with the formation, especially in the superficial layers, of large thin-walled blood sinuses. Blood escapes from these sinuses into the stroma, and here and there small hæmatomata raise up the epithelium from the stroma. Lymphocytes move upwards from the lymph nodes of the basal layer, and by the end of the phase there is a well-marked lymphocytic infiltration of the whole endometrium.

The endometrium approaches the form characteristic of the early stages of pregnancy (p. 76). All three layers can be identified: (1) *the basal layer*, containing the bases of the glands and penetrating among the muscle bundles; (2) *the stratum spongiosum*, containing the widely dilated lumina of the intermediate portions of the glands, and (3) *the stratum compactum*, containing the large stroma cells which will form the decidual cells should fertilisation occur. Another point of resemblance to early pregnancy is the accumulation of glycogen in the endometrium in this and the succeeding phase.

During this phase a *corpus luteum* has been developing rapidly from the Graafian follicle, which shed its mature ovum at the end of the preceding phase (p. 58). The endometrial changes are due to the continued action of the follicular hormone, which was potent in the preceding phase, supplemented by the action of the hormone of the corpus luteum. Both hormones are in turn controlled by the gonadotropic hormones of the anterior lobe of the pituitary gland. This corpus luteum begins to degenerate two days before the end of the phase, and there is a sudden cessation of the production of both the follicular and the corpus luteum hormones.

THE MENSTRUAL OR DESTRUCTIVE PHASE.—Degenerative changes suddenly appear in the endometrium—the first signs are noted in the

endothelium of the capillaries of the compact layer. Blood escapes more freely into the stroma, and the adjacent glands disintegrate. The superficial epithelium breaks down, and is shed into the uterine cavity along with red blood corpuscles, leucocytes, stroma cells, and gland debris. The degenerative process extends to the spongy layer, a considerable portion of which is shed in fragments into the uterine cavity. This destruction and shedding of tissue is completed within the first two days of the phase, and by the third day the surface of the endometrium is raw, having been denuded of all the compact layer and the bulk of the spongy layer. The glands in the deeper portion of the spongy layer now open directly into the uterine cavity, into which the

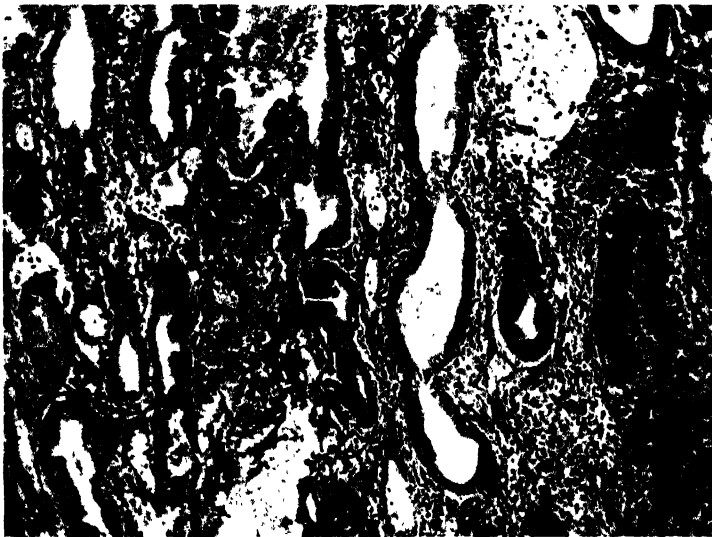


FIG. 27.—Menstrual or Destructive Phase. Endometrium on the second day of active menstruation (H. L. Sheehan).

abraded capillaries continue to ooze blood in varying amount. Occasional fragments of formed tissue may still be identified in the discharge. The discharge escapes from the uterine cavity with the aid of recurrent contractions of the uterine muscle at intervals varying from one to two minutes. The flow through the external os is intermittent and not continuous. These uterine contractions are usually painless.

Reparative processes can already be identified by the third day, and before the end of the phase epithelium is spreading from the lining of the glands to cover over the exposed stroma.

This process of disintegration is due to the sudden withdrawal of the follicular and the corpus luteum hormones, which took place at the end of the preceding phase. Then retrogressive changes were appearing in the corpus luteum—the cells showed hyaline changes with vacuolation, and were acquiring their distinctive yellow colour from the deposit

of *lutein*, a lipochrome, within their substance. While these changes may account for the withdrawal of the corpus luteum hormone, the simultaneous withdrawal of the follicular hormone is more difficult to explain. The degenerative process in the corpus luteum continues throughout this phase, but several months elapse before the completely atrophic form, the *corpus albicans*, is reached. Had fertilisation occurred the corpus luteum would have continued its development (*vide* p. 27), and the endometrium would have passed from the secretory phase to the complete decidual endometrium of pregnancy (*vide* p. 48).

THE POSTMENSTRUAL OR REGENERATIVE PHASE.—The reparative processes noted in the second half of the preceding phase continue. Proliferation of the epithelium of the glands provides a complete new covering for the uterine cavity. A large number of lymphocytes are at first seen in the stroma, but as the glands resume their simple tubular form, described at the beginning of the proliferative phase, and the stroma becomes readjusted, few lymphocytes are seen. The free blood corpuscles scattered through the stroma at the end of the destructive phase are again collected into the new capillaries or otherwise split up and removed.

Within the ovaries, during this phase, the degeneration of the recently active corpus luteum continues. In another part of the ovary, or in the other ovary, another Graafian follicle is approaching maturity and will control the next menstrual cycle. These ovarian changes are continuously controlled by the hormones of the anterior lobe of the pituitary gland.

THE MENSTRUAL FLUID.—The amount of fluid lost at a menstrual period varies very widely, from 2 to 8 ounces being within normal limits. The exact estimation of the amount is very difficult, and, where it may be desirable to ascertain the exact amount, calculation has to be made from the hæmoglobin obtained from all the diapers. A rough practical estimate may be made from the number of diapers used—as a rule, three per day—or by weighing the diapers before and after use. The amount varies with the individual, and even in the same individual at different times.

The flow does not maintain the same characters throughout the period. At first there is blood, considerable mucus, many lymphocytes, and some tissue débris: later there is practically pure blood, while at the end mucus again appears. The flow contains a large amount of oestrone. Blair Bell pointed out that menstrual blood contains a larger calcium content than circulating blood, and, under normal conditions, no fibrin ferment. The fibrinogen is normal in amount.

Normal menstrual blood shows partial hæmolysis and does not coagulate.

Even menstrual blood which has been retained, perhaps for years as in cases of hæmatocolpos or hæmatometra, remains as a thick tarry fluid. This failure to coagulate may be due either to the withdrawal

by the endometrium of the fibrin ferment, or to the secretion by the endometrium of an antithrombin which neutralises the action of the fibrin present. On the other hand, Beckwith Whitehouse believes that the blood coagulates as soon as it is shed into the uterine cavity, thus corresponding to the menstrual clot found inside the uterus in certain monkeys and in cows, and that this clot is then liquefied by the ferments secreted by the endometrium. The majority of gynaecologists believe that the formation of menstrual clots is to be regarded as a pathological condition.

The Mechanism of Menstruation.—Until recent years ideas on this subject were very vague. As the earlier studies were confined to post-mortem human specimens, which we now know to show very marked degenerative changes, the flow of blood was attributed to the activity of the uterine muscle, which drove the blood into the endometrium, where the increased pressure caused fatty degeneration and ultimately disintegration of the vessel walls. A large amount of endometrium was thought to be shed, and then regenerated from the basal tissue.

Later, the process was attributed by Pflüger to a nerve reflex, set up by changes in the size of the developing Graafian follicles in the ovary: the reflex route was through the ovarian nerve, and the response produced was a dilatation of the blood-vessels in the uterine wall. We have now ample experimental proof of the functional independence of the reproductive organs in relation to the central nervous system.

Within the past twenty years there has been a steady accumulation of evidence, experimental and clinical, that the immediate control of the menstrual changes in the uterus rests in the hormones secreted by the ovary, and that these ovarian hormones are further controlled by the gonadotropic hormones secreted by the anterior lobe of the pituitary gland. The relationship of these hormones will be more fully discussed in connection with ovulation (*vide* p. 57). The follicular hormone, secreted apparently primarily by the tissues of the maturing Graafian follicle, is responsible for the proliferative changes which occur in the endometrium from the end of the postmenstrual phase throughout the intermenstrual phase. At the beginning of the premenstrual phase there is added the influence of the hormone, secreted by the corpus luteum, which started development when a mature ovum was shed from the appropriate Graafian follicle. Throughout the premenstrual phase both hormones are effective, and it is their sudden withdrawal from the circulation at the end of this phase which determines the *crumbling necrosis* and other changes which produce the menstrual flow. The extirpation of the corpus luteum at any stage of the premenstrual phase is almost invariably followed by the appearance of a menstrual flow. The exact mechanism by which these hormones produce the specific changes in the tissues of the endometrium cannot be accurately determined, but they are carried in the circulating blood and do have

this specific action in the endometrium only. There are four specific tissue effects : (1) dilatation of capillaries, (2) secretory activity in the epithelial cells, (3) fluid imbibition by stroma cells, and (4) necrosis of epithelial and stroma cells.

The Significance of Menstruation.—From earliest times wonderful and fantastic theories have been evolved to account for the phenomenon of menstruation. In some cases menstruating women have been regarded as unclean creatures, requiring segregation, whose very look might blight the crops or turn wine sour. Menstrual blood has been variously regarded as a deadly poison or as a most beneficial and powerful remedy for ills. The moon has been credited with the control of the phenomenon. Again, it has been held that menstruation is an excretory process allowing the discharge of toxic substances, and that the process should therefore be considered one of self-purification.

More than seventy years ago Powers expressed the view which recent research has tended to confirm, viz. : "Women menstruate because they do not conceive." We have seen that throughout the interval between one menstrual period and the next progressive changes take place in the endometrium, which produce at the end of the premenstrual or secretory phase a uterine lining which is almost indistinguishable from the endometrium in early pregnancy. Those changes appear to have been designed to produce a medium in which the fertilised ovum might become embedded and continue to develop. We have seen the dilatation of the glands, the concentration of large stroma cells in the superficial layer, the deposit of glycogen for its nutrition, and the increased vascularity of the whole tissue.

When we study the time of ovulation in the normal menstrual cycle we shall see that the mature ovum is discharged from the Graafian follicle at a point in the cycle which would allow it to become fertilised, complete its journey along the Fallopian tube, and reach the endometrium in the later part of the secretory phase (*vide* p. 76).

We have seen that the degenerative changes which occur in the menstrual or destructive phase are immediately preceded by the withdrawal from the circulation of the hormone of the corpus luteum and the follicular hormone. When we search for the factor which, when fertilisation does occur, prevents the onset of those degenerative changes, we have the possibility of a hormone formed by the trophoblast of the fertilised ovum, similar to the gonadotropic hormone of the anterior lobe of the pituitary gland, and which can maintain the integrity and continued growth of the corpus luteum and the continued secretion of its specific hormone.

When we compare the menstrual cycle in women with the sexual changes in the lower mammals (*vide* p. 45), we find that the beginning of the premenstrual or secretory phase corresponds to the phase of *œstrus*, and that the later part of the phase corresponds to the phenomenon

of *pseudo-pregnancy*. The onset of the menstrual flow in women corresponds to the end of *pseudo-pregnancy* in the lower mammals.

This interpretation of the phenomenon of menstruation in women may be said to depend on the primacy of the ovum, but certain observations in comparative and human physiology may be regarded as objections to this view. Corner and Hartmann have found that in one of the higher monkeys, *Macacus rhesus*, menstruation may take place regularly, especially in the non-breeding season, without ovulation. Bleeding takes place, in the absence of the proliferative changes associated with the periodic variations in the formation of follicular and corpus luteum hormones, from a thin *anæstrus* endometrium (*vide* p. 45).

In certain women, cyclic menstrual bleeding has been found to occur from an endometrium in which there is no trace of the secretory activity which is produced by the corpus luteum hormone. This abnormal type of human menstruation, described as *anovular*, is associated with sterility, and may be regarded as pathological for the species. While Allen has removed the ovum from the Fallopian tube without disturbing the menstrual rhythm, he did not disturb the corpus luteum in the ovary, the formation of which was dependent on that ovum.

Those variations suggest that we may have to seek a more fundamental cause of menstruation. The immediate control lies in the ovary, the activity of which is regulated by the anterior lobe of the pituitary gland. The sexual activities of the pituitary gland may be related to metabolic variations—it has been observed in certain experiments on vitamin potency that deprivation of vitamin E (*vide* p. 147) is associated with degenerative changes in the anterior lobe of the pituitary gland. Ultra-violet light appears to induce sexual activity in the lower animals, perhaps explaining the summer breeding season. Among Esquimaux menstruation may be restricted to the summer season, and amenorrhœa continue throughout the winter months. The ultimate control of the whole function may rest in a centre in the hypothalamus, liable to stimulation by various external influences.

Clinical Characteristics of Normal Menstruation.—(a) *Subjective Symptoms.*—The group of subjective symptoms associated with the occurrence of menstruation is spoken of as the *menstrual molimen*. While menstruation is a physiological process, it may often give rise to much discomfort, amounting sometimes to actual disability. Allowance must be made for the differing susceptibility of individual women to pain, but series of records of the menstrual histories of large numbers of women show that less than 25 per cent. of them are quite free from discomfort at such times. The discomfort is usually referred to the back, lower abdomen, one or other iliac fossa, more commonly the left. In the premenstrual phase, pelvic hyperæmia may cause a feeling of heaviness and backache (*vide* Dysmenorrhœa, p. 787).

Apart from this, or in addition to it, many women complain of

headache, even migraine, and lassitude, with a feeling of depression or nervousness. A particularly interesting type is where there is impairment of digestion, associated in some cases with nausea and vomiting. This must be regarded as a *menstrual dyspepsia*.

Occasionally the menstrual period is accompanied by an overaction of the sebaceous glands of the face, giving rise to acne-like pustules. In many cases "dark rings" form under the eyes. In practically all cases there is an overactivity of the sebaceous glands of the vulva and perineum. A few have discomfort in the breasts at each period, in some cases amounting to sharp pains. Constipation may appear, or become exaggerated, at the menstrual periods. Frequency of micturition, apparently due to irritability of the bladder, is a common symptom. The premenstrual and menstrual phases are usually associated with an exacerbation of symptoms in pelvic disease.

While in animals the œstrus is the period of *libido sexualis*, in human beings sexual desire is little influenced by the stages of the menstrual cycle. By the Mosaic Law sexual intercourse is forbidden during the menstrual periods, and in that phase there is a general tendency to avoid intercourse, though *questionnaires* on this subject indicate that there is no real diminution of desire. The same method of investigation seems to show a frequent increase during the premenstrual phase, and also, though less frequently, an increase during the postmenstrual phase.

(b) *Objective Symptoms*.—Records of the most easily available clinical data, pulse-rate and temperature, show slight variations in relation to menstruation—there is a tendency to an increase in both just before the onset of menstruation. The blood-pressure may be slightly increased at the end of the premenstrual phase, and fall gradually throughout the actual period. Knee jerks are exaggerated at the beginning of the flow, and muscle power, as tested by the dynamometer, is frequently increased.

The uterus is swollen and hyperæmic, the cervix soft and patent, and the vulva and vagina soft and more patulous.

Investigations into the metabolism of menstruation have shown a retention of nitrogen at the end of the premenstrual phase, which may be a provision against the blood loss which is to occur at the end of this phase. Blair Bell noted a rise in the calcium content of the systemic blood during the same period, and there is an unusually large percentage of calcium in the menstrual blood. Studies of the respiratory exchanges in many women have shown only slight changes during menstruation.

Changes in the characters of the blood during menstruation have been described; particularly a decrease in the number of the erythrocytes, throughout the period, with a compensatory increase in the postmenstrual phase. More accurate records show that the actual decrease and increase hardly exceed the normal limits of variation.

The same findings apply to the hæmoglobin and the leucocytes. The most interesting change in the blood-content is a hyperglycæmia which occurs in the premenstrual phase. The increase may be as much as 0.03 per cent. of glucose, which is considerable when we remember that the normal content of sugar in the blood is only a little over 0.1 per cent. Modern biological investigations show that the œstrin content of the blood increases steadily from the end of one menstrual period until just before the beginning of the next. In the second half of the interval the corpus luteum hormone appears in the circulation and increases in amount until just before the next period, when it practically disappears along with the follicular hormone.

There is a close relationship between the activity of the thyroid gland and the menstrual epochs. At puberty, there is a noticeable enlargement, and as each menstrual period arrives, it is possible in many women to detect a swelling of the gland.

While the actual objective changes in menstruation may not be great in number or of serious clinical importance, menstruation is often a serious economic handicap to women. In some commercial firms where many women are employed in checking small pieces of apparatus requiring very fine adjustment, it has been found an advantage to give each woman worker two days' holiday when her period becomes due, rather than have to correct all the inaccurate adjustments which she may make during those two days.

OVULATION AND THE FUNCTIONS OF THE OVARIES

The ovaries not only produce ova, but also exercise many other functions in the body. They influence body growth throughout the adolescent period, the determination of the female type of bony pelvis, the development of the other organs of reproduction, the regulation of the menstrual function and the embedding of the fertilised ovum in the uterine wall, are all subject to the influence of the ovaries exercised through the internal secretions of their follicles, corpora lutea and interstitial cells. The development and structure of the Graafian follicle with the discharge of the mature ovum, and the formation of the corpus luteum have already been described (p. 27). Under ordinary circumstances the corpus luteum reaches maturity in about fourteen days, and has become quite inconspicuous within six weeks. When pregnancy supervenes, the corpus luteum goes on growing until it reaches its maximum size at the end of the third month ; it still remains a conspicuous object at the end of pregnancy.

Relationship of Ovulation to Menstruation.—On general grounds there would appear to be a very close relationship between these two processes. They both appear about the same epoch and, remaining closely associated throughout the active sexual life, disappear about the same time. There is ample evidence that the two processes

are not essential to each other, because ovulation, as proved by the occurrence of conception, may occur when menstruation has not been established or is in abeyance—*e.g.* before puberty, during lactation or during the amenorrhœa of anæmia. On the other hand, menstruation has been shown to occur in the higher monkeys in the absence of ovulation, and an anovular type of menstruation appears to occur in some women (*vide* p. 53).

Ovulation occurs in the normal 28-day menstrual cycle about 14 days from the onset of the preceding period—Schroeder believes that the range of variation does not exceed 4 days. Where the menstrual cycle is abnormal, the most reliable estimate of the date of ovulation is obtained by calculating back 14 days from the onset of the succeeding menstrual period, or, should fertilisation have occurred, the date on which the menstrual period was expected. This may be of great importance in estimating the expected date of labour in women who have a consistent type of prolonged menstrual intervals. This retrospective estimate is based on the normal period of functional activity of the corpus luteum.

The determination of the fourteenth day as the date of ovulation has been arrived at from at least three sets of evidence :—

(1) Ovaries removed at operation have been examined histologically and the stage of development of the Graafian follicle or early corpus luteum related to the menstrual history. The early corpus luteum is a greyish structure which may escape naked-eye observation—the easily identified yellowish nodule on the surface of the ovary is a late stage of development. (2) Allen has recovered human ova by washing through the Fallopian tubes at operation, and shown that ovulation is almost restricted to the fourteenth day. (3) Having established the relationship of the endometrial changes to the changes in the Graafian follicle and corpus luteum, we find that the secretory changes in the endometrium produced by the hormone of the corpus luteum, begin from the fourteenth day. This last is an indirect method, but gives very constant results.

Embryologists find it difficult to accept this view of the limitation in the date of ovulation. They have attempted to time the relationship of ovulation and menstruation by the study of early ova with reference to menstrual histories. The best study of this type is probably that of Teacher and Bryce, whose results tend to show that fertilisation may occur at any stage during the intermenstrual phase and that imbedding may take place either in the period of quiescence or in the period when premenstrual or menstrual changes would have been progressing if pregnancy had not occurred.

Ovarian Hormones.—Within recent years great progress has been made in our knowledge of the sex hormones, the most important of which are normally produced by the ovaries. The active principle of the follicular hormone, *œstrone*, was isolated in pure crystalline form in

1929, while the active principle of the corpus luteum hormone, *progesterone*, was isolated in 1934. Progesterone has now been synthesised from stigmaterol. All the sex hormones are apparently derived from cholesterol.

(a) *The Follicular Hormone*.—The follicular hormone is found in (a) a relatively inactive form, *œstrone*, and (b) an active form, *œstradiol*, which is about five or six times more potent than *œstrone*, and is now regarded as the true hormone of the ovary. Those hormones are found in the various components of the Graafian follicle where they are normally produced, and also in the ovarian stroma; they can also be identified in the corpus luteum. They occur in the blood and the urine of non-pregnant women in concentrations characteristic of each stage of the menstrual cycle. The greatest concentration occurs about two days before the onset of the menstrual flow, and then there is a very sudden drop to zero. Menstrual blood contains large quantities. This hormone is not confined to the female sex; it occurs in high concentration in the urine of stallions, and is found in the testes of that animal. It is also found in other species of the animal kingdom.

During pregnancy large amounts of follicular hormone are excreted in the urine. The excretion of *œstrone* increases steadily throughout pregnancy until the onset of labour, when it falls very rapidly. *œstradiol* is excreted in relatively small amount until just before the onset of labour, when it rises very rapidly, and then just as rapidly falls to zero. During pregnancy the placenta appears to take a considerable share in the secretion of *œstrone* and *œstradiol* (p. 135), when the ovaries are removed during pregnancy the excretion of the follicular hormones goes on unchanged. In pregnancy the follicular hormones are probably closely associated with the growth and maintenance of the uterus and the accessory organs: they are also associated with the growth and activity of the breasts.

We have noted the action of the normally secreted follicular hormones on the endometrium throughout the menstrual cycle. When the hormones are administered either experimentally or therapeutically certain characteristic results are noted. They do not affect the cardiovascular system or general metabolism. When administered to castrated female animals they produce in the uterus and vagina the proliferative changes characteristic of the phase of *œstrus*. The uterus becomes enlarged from hyperæmia, the cavity is increased, and the mucous membrane becomes thickened: the mucous membrane of the vagina becomes thickened, and cornified cells are shed into the lumen. In those monkeys which have a menstrual cycle the injection of *œstrone* into a castrated female produces similar hypertrophic changes in the endometrium and associated tissues: when the injections cease the hypertrophied endometrium degenerates and the necrosed tissue, with blood, is shed into the uterine cavity. The same effect is found when *œstrone* is injected into oöphorectomised women: the uterine

hæmorrhage in each case corresponds to the type of bleeding which may occur abnormally in certain women, and normally in bitches, during the proliferative phase of the menstrual cycle.

Prolonged and massive doses of œstrone produce in the higher monkeys and in women a cystic endometrial hyperplasia. When it is injected into immature animals the development of the ovaries is arrested: in mature animals large doses inhibit conception, or, if pregnancy is already established, cause abortion. The most important effect is that prolonged administration of œstrone causes hypofunction of the anterior lobe of the pituitary gland, with secondary atrophy of the internal and external organs of reproduction. This effect shows that the continued administration of œstrone may have an adverse effect on the individual, but fortunately those effects can be reversed either by stopping the administration of œstrone or by administering progesterone.

The follicular hormones have become accepted as standard therapeutic agents. They act only by substitution and can have only temporary effects. They may be employed in cases of ovarian hypofunction, such as underdevelopment of the uterus, amenorrhœa, dysmenorrhœa, and sterility, but their use in such cases is still somewhat empirical. They have proved most satisfactory in the treatment of the vasomotor disturbances associated with the menopause, and those painful atrophic lesions of the vulva, *leukoplakia* and *kraurosis vulvæ* (*vide* pp. 887, 888).

The use of the follicular hormones therapeutically has necessitated standardisation. The original standardisation was based on biological tests, viz., the smallest quantity of hormone which, given in three equally divided doses at four-hourly intervals, would produce œstrus (the cornification and desquamation of the vaginal epithelium) in the mature spayed mouse or rat at the end of three days after the first injection. Fortunately it has now become possible to express dosage in terms of pure crystalline hormone. We use either the *International Unit* (*I. U.*), which is the specific œstrus-producing effect of 0·0001 mg. of pure crystalline œstrone, or the *International Benzoate Unit* (*I. B. U.*), representing the specific effect of 0·0001 mg. of pure œstradiol benzoate—œstradiol is usually employed in the form of the benzoate (*vide* Chapter XLIII).

(b) *The Corpus Luteum Hormone.*—The corpus luteum is peculiar to the mammalian group, and is associated with the intrauterine development of the foetus. The essential hormone, identified as *progesterone*, has therefore appeared late in the evolution of the sex hormones. It is found in the circulation in the secretory phase of the menstrual cycle, and disappears about two days before the end of this phase. Unlike œstrone and œstradiol, it is not excreted in the urine to any extent. The function of this hormone is to prepare the uterus to receive a fertilised ovum and to maintain the ovum in the uterine wall in early pregnancy

We have seen that progesterone produces certain specific changes in the endometrium, which has already been sensitised by the follicular hormones : it has no action on the endometrium not so sensitised. Loeb showed that in the secretory phase of the endometrium in rabbits a decidual reaction could be produced by such simple stimuli as scratching the endometrium : when the corpus luteum was removed this reaction could no longer be obtained.

Progesterone is responsible for some very important effects during pregnancy. While in the menstrual cycle it is synergistic with the follicular hormones, it can also exert an antagonistic effect : it inhibits the maturation of Graafian follicles, and by that means suspends ovulation during pregnancy. In the lower animals the removal of the corpus luteum in the early stages of pregnancy causes abortion : in women the fact that pregnancy may continue after removal of the ovary containing the corpus luteum is believed to be due to the very early secretion of progesterone by the trophoblastic or chorionic tissue. The mechanism by which progesterone stabilises the ovum in the endometrium in the early stages of pregnancy is not known, *but we do know that progesterone inhibits the activity of uterine muscle*. Observations in animals show that the uterine muscle is relatively insensitive to the hormone of the posterior lobe of the pituitary gland until just before the end of pregnancy : experiments on isolated uterine muscle show that progesterone prevents the normal response to the administration of that hormone. While we have seen that the follicular hormones produce hypertrophic changes in the breasts, the administration of progesterone produces more extensive hypertrophic changes in the breast tissue.

Progesterone has been accepted as a standard therapeutic agent. As it is destroyed by the gastric juices, it should be administered by intramuscular injection. Its inhibitory action on the activity of uterine muscle has indicated its use in certain forms of dysmenorrhœa, though this therapy is still empirical. In gynæcological functional lesions associated with excessive or irregular uterine hæmorrhage, in which there may be either an overproduction of follicular hormone or a deficiency of progesterone, as in *metropathia hæmorrhagica* (p. 777), the administration of progesterone may be helpful. The most satisfactory results with progesterone have been obtained in the treatment of cases of *habitual abortion* (p. 334).

Progesterone has also been standardised biologically in terms of the amount required to produce secretory changes in the endometrium of an immature rabbit already sensitised by œstrin. For administration the dose is now calculated by weight of the pure crystalline hormone.

Other Forms of Ovarian Activity.—The ovaries play a very important part in the control of somatic development. Though congenital absence of the human ovaries is a very rare condition, and surgical castration is rarely practised in adolescent girls, ample evidence

regarding the influence of the ovaries on growth has been obtained from experiments on animals. Surgical removal in young animals leads to increased skeletal growth through delayed ossification of the epiphyses of the long bones, to the increased deposit of subcutaneous fat, and to incomplete development of the external organs of reproduction. This clinical picture is of peculiar interest in that it contains the same features as are produced by hyperactivity of the pituitary gland. In this respect there would therefore seem to be an antagonistic action between the ovaries and the pituitary gland.

During the prepubertal period, or period of growth, the components of the ovaries are the follicular systems, the interstitial cells, and the stroma cells—the corpora lutea have not yet appeared. The *interstitial cells* are much less conspicuous in human ovaries than in the ovaries of the lower animals, but in women they do appear histologically to be most numerous and active during the prepubertal period. They reappear in large numbers during pregnancy. We have seen that ovulation is arrested during pregnancy, though the ripening of follicles continues (p. 59); this is a reversion to the prepubertal type of follicular activity. No definite hormone has been identified as associated with the interstitial cells, even in the lower animals where they are so concentrated as to be described as “interstitial glands.” They are present in the human ovary until the menopause and probably exercise some function. In the prepubertal they appear to be associated with the direction of somatic development, such as the determination of the female type of bony pelvis, and to influence the growth of the accessory organs of reproduction and the development of the secondary sex characteristics.

Removal of the ovaries after puberty is not followed by a retrogression of the secondary sex characteristics: there are atrophic changes in the uterus, vagina, and vulva, with certain vasomotor and metabolic disturbances, all of which normally occur after the menopause (p. 65). There is no alteration in the shape of the pelvis, the form of the breasts, or the distribution of the subcutaneous fat and pubic hair. The determination and control of the secondary sex characteristics do not depend on the gonads alone. There appears to be a neutral type for each species—Pezard has shown that the removal of the gonads in birds of both sexes leads to the development of a neutral type. In the human species the female approaches more closely to the neutral type than the male: the two features which in women appear to be directly due to the internal secretions of the ovaries are the shape of the bony pelvis and the hypertrophy of the breasts after puberty. We have seen that the former may be due to the action of the interstitial cells, while the latter depends on the action of the corpus luteum which cannot become operative until ovulation has been established.

Irregularities in sex conformation have been described frequently

in human beings, the external configuration of one sex associated with the gonad of the other sex. Blair Bell epitomised the modern view of

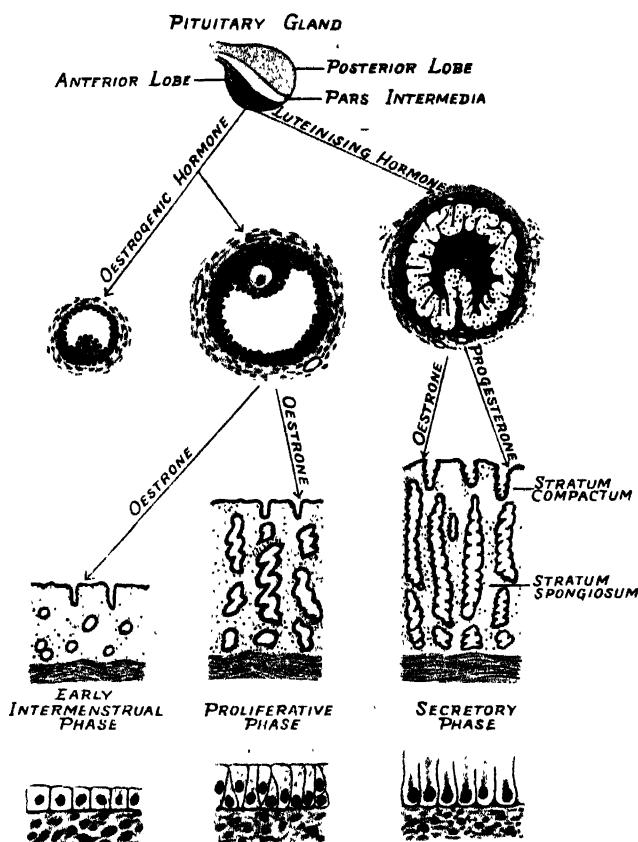


FIG. 28.—Diagrammatic Figure to show the Relationship between the Hormones of the Anterior Lobe of the Pituitary Gland and of the Ovary, and the Changes in the Endometrium throughout the Menstrual Cycle (after Graves).

this study in the words : "Propter secretiones internas totas, mulier est quod est."

THE OTHER ENDOCRINE GLANDS

Pituitary Gland.—(1) The **ANTERIOR LOBE OF THE PITUITARY GLAND** of all the endocrine glands appears to be the most closely related to the physiology of reproduction. It does exercise a multiplicity of functions in the control of body processes by the secretion of a number of hormones, among which are (a) the growth-stimulating ; (b) the gonadotropic ; and (c) the lactogenic hormones.

(a) *The growth-stimulating hormone* only affects the reproductive organs in association with the growth of the whole body. In *pituitary infantilism* there is an arrest of body growth with marked underdevelopment of the reproductive organs. The secondary sex characters are absent—there is no growth of pubic hair and the breasts remain ill-developed. Cushing has produced in dogs a condition resembling acromegaly by intraperitoneal injection of this hormone. *Acromegaly* is associated with hyperplasia of the acidophil cells of the anterior lobe: there is usually an associated hypertrophy of the suprarenal cortex, and, in the later stages of the disease, amenorrhœa. In *Fröhlisch's syndrome*, which is believed to be due to irregular function of the chromophobe or "chief cells" of the anterior lobe, there is an excessive deposit of fat in the breasts, abdomen and hips, with atrophic changes in the reproductive organs, amenorrhœa and sterility.

(b) *The gonadotropic hormone* controls the growth, structure and function of the ovary, and so influences the other organs of reproduction and the secondary sex characters. Experimental removal of the pituitary gland causes the arrest of the œstrous cycle, together with atrophic changes in the ovaries and the uterus; these effects can be prevented by grafts of the anterior lobe. This control of the œstrous changes of the endometrium by the anterior lobe can only be exercised through the ovaries. In the lower animals "mating" appears to stimulate the function of the anterior lobe; in animals such as the rabbit, where ovulation normally follows coitus, this does not occur after hypophysectomy, but extracts of the anterior lobe, injected into such hypophysectomised animals, will induce ovulation without coitus. Ovaries from immature animals, grafted into castrated adult animals of the same species, rapidly assume the characters of the active adult ovary; but mature adult ovaries, grafted into an immature animal under the same circumstances, lose all evidence of activity and revert to the immature state. This variation in effect is due to the anterior lobe of the pituitary gland which in the second grafting experiment had not yet reached maturity.

The gonadotropic hormone produces two effects: (a) the *œstrogenic*—the ripening of the Graafian follicles, the maturation of ova and the associated proliferative changes in the endometrium; and (b) the *luteinising*—the development of the corpora lutea with secretory changes in the endometrium. These effects may be due to the action of two separate hormones, or to the same hormone producing different effects when acting in different concentrations. In the belief that there were two separate hormones, Aschheim and Zondek named the œstrogenic hormone of the anterior lobe *Prolan A*, and the luteinising hormone *Prolan B*. It may be impossible to arrive at a decision on this point until the hormone or hormones concerned are established as specific chemical bodies, as œstrone and progesterone have been—

at present the gonadotropic hormones can only be recognised as having the characters of proteins. The hormone does not appear to be sex-specific as are œstrone and progesterone.

The urine of pregnant females and their placenta contain relatively large amounts of hormones which in their physiological reactions closely resemble the gonadotropic hormone of the anterior lobe. This gonadotropic hormone of pregnancy appears to be elaborated by the chorionic villi of the placenta. The Aschheim-Zondek and Friedman tests for pregnancy depend on the presence in the urine of hormones closely resembling the gonadotropic hormone of the anterior lobe. The hormone is more easily extracted from the urine of pregnant women than from pituitary or placental tissue. Most of the commercial preparations available for clinical use are prepared from pregnancy urines and produce essentially the luteinising effect; the œstrogenic principle has not been eliminated and this fact may make such preparations less suitable for the treatment of threatened or habitual abortion. Recently a preparation of the gonadotropic hormone, *Antex*, has been secured from the serum of pregnant mares, and appears to have a definite effect upon the development of the Graafian follicles, ovulation and the secretion of œstrone.

During pregnancy the amount of gonadotropic hormone in the urine rises progressively until the end of the fifth month, and then decreases steadily until full time. The hormone disappears very quickly from the urine after labour. Compare this with the œstrone content of the urine, which increases steadily up to the onset of labour (*vide* p. 57). Since the gonadotropic function of the anterior lobe appears to be suspended during pregnancy, we have the more reason to believe that the gonadotropic hormone of pregnancy is elaborated by the chorionic villi.

The presence of œstrone in the blood in sufficient concentration causes inhibition of the secretion of gonadotropic hormone by the anterior lobe in women (*vide* p. 60). The activity of the ovary is thus inversely related to the gonadotropic function of the anterior lobe; continued œstrone formation leads to diminution of gonadotropic hormone function, which in turn inhibits ovarian activity and allows the anterior lobe to renew the cycle by increased production of gonadotropic hormone.

For clinical purposes the gonadotropic hormone of the anterior lobe has been standardised in rat units—the unit is the smallest amount of the hormone which will bring about follicle ripening and luteinisation in the immature female rat. *Antex*, the hormone extracted from the serum of pregnant mares, has been standardised in mouse units—the unit is the amount of hormone which will double the weight of the ovary of an immature female mouse, aged three to four weeks, in three to four days. Gonadotropic hormones must be administered by subcutaneous or intramuscular injection. The hormone

may be employed for the treatment of amenorrhœa or scanty menstruation, and sterility, associated with infantilism, delayed puberty and insufficient follicle formation. It may also be employed in cases of deficient corpus luteum formation, such as metropathia hæmorrhagica and other forms of functional uterine hæmorrhage. Overstimulation of the ovary by gonadotropic hormone may lead to excessive follicle formation—in one experiment of this type a pregnant mouse was found to have twenty-nine foetuses. Injection of the hormone into senile mice produces reactivation of the ovaries, with the reappearance of the œstrous cycle, and even pregnancy.

(c) *The lactogenic hormone of the anterior lobe* is responsible for the initiation of the secretion of milk. The hypertrophy of the mammary gland which takes place during pregnancy is probably due to the œstrogenic hormones rather than to the action of progesterone (p. 128).

(2) **THE POSTERIOR LOBE OF THE PITUITARY GLAND.**—Three hormones have been identified in the substance of the posterior lobe; but as this lobe consists chiefly of connective tissue and neuroglia, it is believed that the hormones are actually secreted by the epithelial cells of the *pars intermedia* which penetrate into the posterior lobe, and are only stored in the posterior lobe. The first hormone is the oxytocic, usually referred to as *pitocin*, which controls the contraction of uterine muscle. The action of this hormone is reinforced by œstrone and inhibited by progesterone. The second hormone is the pressor, referred to as *pitressin*, which produces a sustained rise of arterial blood-pressure and also stimulates peristalsis in the gastrointestinal tract. The third hormone is an *antidiuretic*, which has been employed in the treatment of diabetes insipidus.

The Thyroid Gland.—The close relationship of the thyroid gland to the reproductive organs has long been recognised: enlargement of the thyroid during pregnancy has been described since the days of Hippocrates. In extreme *hypofunction* of the thyroid, such as cretinism, there is usually amenorrhœa, though occasionally only delayed puberty. In myxœdema there may be profuse or frequent periods, with a tendency to amenorrhœa if the condition persists. Similarly, *hyperthyroidism* is at first associated with profuse and frequent periods, while in advanced exophthalmic goitre it is usual to find amenorrhœa with atrophic changes in the reproductive organs.

The Parathyroid Glands.—The parathyroid glands do not appear to be closely associated with menstrual function; but they assume considerable importance when we come to consider some of the problems of pregnancy, where they may be closely associated with disturbances in calcium metabolism (*vide* p. 155).

The Thymus Gland.—Temesvary describes extracts of this gland as powerful stimulants of isolated uterine muscle. Removal of the gland in immature animals has been found to accelerate sexual development.

The Pineal Gland.—Tumours of this gland have been associated with precocious puberty, but such tumours are usually teratomata, and the abnormal development need not be due to the gland tissue.

The Suprarenal Glands.—Variations in the development of the suprarenal cortex have been found in certain abnormalities of the reproductive organs. Tumours of this gland in children are associated with precocious puberty. In adults this gland may be the seat of a rare type of virilising tumour, with atrophy of the uterus and the breasts, amenorrhœa, hypertrophy of the clitoris and male distribution of hair; those irregularities disappear when the tumour is removed.

The Pancreas.—In cases of diabetes mellitus there is a depression of sexual function. Where the lesion is progressive, atrophic changes take place in the reproductive organs; amenorrhœa appears quite early.

THE MENOPAUSE

The menopause marks the end of reproductive life. The menstrual periods may cease quite suddenly, but as a rule they gradually diminish in frequency and amount until they disappear completely. The age at which the menopause occurs varies very widely—in 50 per cent. of women, between forty-five and fifty; in 25 per cent., between forty and forty-five; in 12·5 per cent., between thirty-five and forty; in 12·5 per cent., between fifty and fifty-five. It occurs, as a rule, later in married women than in single; in those who have borne children later than in those who have not. Again, it occurs early in those women who reached puberty late, and continues longest in those who began to menstruate early. The duration of sexual life appears to be a function of the sexual endowment of the individual. A very early menopause is usually due to some endocrine disorder associated with hypofunction of the anterior lobe of the pituitary gland or of the ovary. A late menopause may be associated with fibromyomatous or adenomyomatous tumours of the uterus, or with some irregularity in pituitary or ovarian function.

STRUCTURAL CHANGES AT THE MENOPAUSE.—The reproductive organs show progressive atrophic changes. The ovaries diminish in size; the surface becomes wrinkled and irregular—the “peach-stone” ovary. The epithelial elements, including the Graafian follicles, disappear; the interstitial cells remain for a few months, but within a year from the cessation of periods all signs of ovarian activity are lost. By this time microscopic examination shows little but fibrous tissue. Occasionally some follicles undergo cystic dilatation, and this variation may be associated with irregular or excessive uterine hæmorrhage.

The walls of the Fallopian tubes lose their muscle tissue; the plicæ become less conspicuous and the lining epithelium loses its cilia.

The uterus becomes reduced in size, and the cervix atrophies until it may just be recognised as a dimple in the vaginal vault. The muscle

of the uterine wall is gradually replaced by fibrous tissue. The endometrium becomes thin; it is now represented only by the deeply staining basal layer with a few simple tubular glands. The functional layer is lost and proliferative changes no longer occur. In some women the endometrium persists as a thick layer for many years after the menopause. Occasionally some of the endometrial glands undergo cystic dilatation before the menopause, and those cystic structures may still be identified in the thinned-out uterine lining after the menopause.

The vagina alters in shape; the wider vault shrinks until the whole canal takes the form of a cone with its base at the vulva and its apex at the external os. The mucous membrane becomes pale and transparent; the cells lose their glycogen. The bacterial content alters; Döderlein's bacilli disappear and the flora changes to the mixed type. The vaginal epithelium now shows poor resistance to infection, and is liable to be the seat of a senile vaginitis (p. 897).

The shrinking of the vagina tends to draw the uterus down into the position of retroversion. The pelvic cellular tissue becomes lax and the supports of the uterus, especially in parous women, lose their tone. Where the cervix is hypertrophied, descent of the uterus frequently occurs, and many women notice prolapse of the uterus for the first time after the menopause.

The labia majora and the mons veneris atrophy, lose their subcutaneous fat and hair, and expose the labia minora. The epithelium covering the labia minora and the vestibule becomes pale and dry. The vaginal orifice becomes narrowed. Those atrophied tissues are very easily abraded.

There is usually a tendency to obesity. The breasts, however, lose their periglandular fat and may shrink or become more pendulous. Hairs appear on the lips and the chin.

The atrophic changes in the ovary are accompanied by a diminution in the secretion of ovarian hormones. This is associated with an oversecretion of the gonadotropic hormones of the anterior pituitary lobe. Those two sets of hormones maintain a balance; undersecretion of the one set leads to hypersecretion of the other and vice versa. One of the most characteristic features of the menopause is the increasing concentration in the urine of the gonadotropic hormone of the anterior pituitary lobe. There is usually a decrease in thyroid activity. The menopausal tendency to masculinity has been attributed to hyperfunction of the suprarenal cortex. The tendency to vasomotor disturbances, hyperpiesis and glycosuria, characteristic of this epoch, may be due to an increased secretion of adrenalin.

THE SYMPTOMS OF THE MENOPAUSE.—While the cessation of menstruation is a local manifestation, women are at this time liable to a series of more general disturbances. Only a few women pass the menopause without disturbing symptoms: some are incapacitated by

the severity of those symptoms. The most frequent and characteristic symptom is "flushings"—waves of vasodilatation, limited to the face and neck, accompanied by sweating, followed by chilliness, and lasting from ten to fifteen minutes. The blood-pressure may be raised, but as a rule only temporarily; headaches and noises in the ears are common. Cardiac irregularity, palpitation and attacks of giddiness also occur. Digestion may be disturbed with flatulence and constipation. Backache and pains in the joints are so frequent that *menopausal fibrositis* and *menopausal arthritis* are sometimes described. Sensations of "pins and needles" in the extremities are very common. Varying degrees of mental disturbance occur—from irritability or depression on to something approaching insanity. Sexual feeling may be increased during the actual menopausal changes and this may be due to the irregular development of Graafian follicles.

Pseudocyesis or "phantom pregnancy" (*vide* p. 177) occurs most frequently at this epoch. The disturbed mental attitude of the woman leads her to attribute her amenorrhœa to pregnancy, and to regard her increasing stoutness as confirmatory evidence.

Special notice must be given to the popular belief among women that at the menopause irregular uterine hæmorrhage is a normal phenomenon. Where there is any deviation from the usual types of arrest of menstrual bleeding the patient should be most carefully examined for evidence of malignant uterine lesions, which unfortunately have their greatest frequency just before or soon after the menopause.

The group of disturbing symptoms which have just been described as occurring at the menopause do not always coincide with the cessation of menstruation: they may appear while the periods are still regular, or may continue for a long time after the periods have ceased. Whereas the cessation of periods is associated with certain easily identified changes in the ovaries and uterus, the generalised disturbance of body function appears to be due to a much more extensive change. Practically all the special symptoms which have been described are related to the sympathetic nervous system. We may describe them as climacteric or due to changes in the whole body, whereas the menopause is a factor of a relatively small group of organs. In over 80 per cent. of women the two series of changes are coincident: the oestrogenic hormones disappear from the blood and the urine in these women within three years from the cessation of periods; but in over 10 per cent. of women these hormones may still be present in the blood and urine twenty years after the menopause.

THE ARTIFICIAL MENOPAUSE.—The surgical removal of the uterus takes away the vehicle of menstruation, while the removal of the ovaries takes away the immediate activator of the function. The treatment of malignant disease of the uterus or ovaries by radium or deep X-rays will produce an artificial menopause, and treatment of certain forms of functional uterine hæmorrhage, such as *metropathia*

hæmorrhagica (p. 788), by the same methods will give the same result. When one or both ovaries are saved at the operation of hysterectomy the ovarian tissue undergoes gradual atrophic changes until by the end of two years no trace of functional activity can be identified.

The degree of general disturbance following the artificial menopause is very variable. The general principle may be accepted that conservation of ovarian tissue helps to diminish the severity of menopausal disturbance after hysterectomy, but some women who have both ovaries removed at this operation are less disturbed by such symptoms than others who have both ovaries saved. Women between twenty and twenty-five years of age who have had the uterus and ovaries removed are sometimes singularly free from menopausal disturbance. Ovarian grafts have been extensively employed to relieve the symptoms of the artificial menopause, but the grafted tissue loses its functional value in about the same time as the normal ovary retained in its normal situation at operation. Now that administration of œstrone has proved so satisfactory in the relief of menopausal symptoms, the employment of ovarian grafts is less necessary.

THE TREATMENT OF MENOPAUSAL SYMPTOMS.—The disturbing symptoms of the menopause are seldom so severe as to require special treatment. Where the symptoms are slight, special attention to diet, bowel function, rest and exercise, with some personal reassurance, is usually sufficient. When nervous symptoms are most prominent, the administration of bromides in 10-grain doses thrice daily is usually effective. A tendency to hypothyroidism can be checked by small doses of thyroid extract. *A great advance in the treatment of the disturbances of the menopause has been made with the introduction of œstrogenic hormones as therapeutic agents.* An exact scientific therapy could be based on the estimation of the hormone content of the urine and on the examination of smears from the vagina, but for practical purposes the oral administration of 1000 International Units of œstrone thrice daily should be tried empirically. The patient's response to treatment, particularly the disappearance of flushings, guides the further treatment. There are very few patients who require the administration of large amounts of hormone by injection. Slight overdosing may cause headaches, and great excess will occasionally produce uterine hæmorrhage. This therapy has proved most helpful in certain post-menopausal lesions associated with ovarian deficiency, such as *pruritus vulvæ*, *leukoplakia* and *kraurosis* (*vide* pp. 886, 887).

CHAPTER IV

EARLY DEVELOPMENT OF THE EMBRYO, MEMBRANES AND DECIDUA—ANATOMY OF IMPLANTATION—DEVELOPMENT OF THE REPRODUCTIVE ORGANS—ABNORMALITIES OF THE REPRODUCTIVE ORGANS

IN a preceding section we have seen that the ovum enveloped by the adjacent cells of the discus proligerus escapes from the ovary about midway between two "periods" (p. 56). According to Westman¹ the dehiscence of the ovum is no mere haphazard process. He claims to have shown that, as the result of muscular movements in which the ovary collaborates through the ovarian ligament, the fimbriated end of the tube stretches over the corresponding surface of the ovary to receive the ovum as it is shed. Westman's investigations were carried out in rabbits, monkeys and, latterly, in women. A somewhat similar view was held from early times. By the ciliary action of the mucous membrane of the tube a constant stream of fluid is kept flowing from peritoneal cavity to uterus and, caught in this stream, the ovum is carried inwards towards the womb.

The ripe ovum is about $\frac{1}{160}$ inch (0.2 mm.) in diameter. Before being fertilised it passes through the process of maturation, extruding first one, then a second *polar body*. In the end it possesses half its original number of chromosomes. The spermatozoon by a similar process has lost half its chromosomes before its escape from the testicles. At fertilisation the head of the sperm-cell containing the nuclear elements burrows into the ovum, where it becomes a spindle-shaped mass—the *male pronucleus*. This fuses with the reduced nucleus of the ovum—the *female pronucleus*. By the union of the male and female elements the fertilised ovum, now termed the *zygote*, regains its original number of chromosomes, half being maternal and half paternal, and in this way, it is believed, the hereditary characters of the two sexes are conveyed to the foetus.

Observations in lower animals have shown that fertilisation of the egg-cell occurs in the Fallopian tube, and it is probable that this is the normal site in the case of women. The process by which the spermatozoa reach the tube is not fully understood. The motility which they possess—it has been estimated that the sperm cell can move at the rate of 1 inch (2.5 cm.) in from seven to eight minutes—may be the

¹ Westman, A., *Journ. Obst. and Gyn., Brit. Emp.*, 1937, vol. xlv., No. 5, p. 821.

sole factor. It is possible that during the female orgasm there is in addition brought into operation an active upward suction of the mucous plug which occupies the cervix and into which the spermatozoa have passed.

There is considerable uncertainty in regard to the length of time the unfertilised ovum and the spermatozoa can survive in the genital passages. It has until recently been generally understood that, whilst the survival period of the ovum was short and, at the most, probably no more than twenty-four to forty-eight hours, the sperm cells, on the other hand, were capable of surviving for a considerable period, even for several weeks. More recent work has, however, claimed to show that this is incorrect and that, although exhibiting no recognisable histological change, spermatozoa which have been ejected for longer than twenty-four to forty-eight hours have in reality completely lost their potency. The time of survival of the sex cells in the genital canal is of considerable practical importance, as on it depends the validity or otherwise of the so-called "safe period." The recent observations of Knaus¹ and others, which seem to establish the existence in the normally menstruating woman of a circumscribed period during which she is sterile, argue for a survival interval that must be short in regard to both sex cells (p. 817).

Sex Determination.—Formerly it was believed that the factors responsible for sex determination only began to operate at some period after segmentation of the zygote had begun. The fact, however, that twins developing from a single ovum (uniovular twins) are always of the same sex has for long suggested that sex must be determined at an earlier stage. Many years ago Wilson, Morgan and others suggested that sex was determined even before fertilisation, and that it was the spermatozoon which exerted the primary influence. More recently, Painter,² Evans and Swezy³ and others have shown that, whilst the ovum contains forty-eight chromosomes which are all alike, the sperm cells possess forty-six chromosomes which are identical and one pair of differing sizes, a large *x* and a smaller *y*. It thus happens that after nuclear reduction there will be present two types of spermatozoa, each with twenty-four chromosomes, but one possessing an *x*, the other a *y* chromosome. It is suggested that fertilisation of the ovum with the *x* spermatozoon produces a female, with the *y* spermatozoon a male child.

Male and female babies are produced in differing proportions; although these vary from time to time and in different communities, they exhibit a remarkable constancy in favour of the male in a ratio of about 106 to 100. Whilst this represents the relation existing at birth it is now recognised that this sex discrepancy is even greater at earlier stages of intrauterine development. Streeter and his pupils

¹ Knaus, *Periodic Fertility and Sterility in Women*, Vienna, 1934.

² Painter, *Journ. Exper. Zool.*, 1923, p. 37.

³ Evans and Swezy, *Mem. Univ. Calif.*, Berkeley, 1929, p. 9.

have shown that a relatively high proportion of aborted ova are male ; in 1200 specimens Schultz¹ found 110 male to 100 female ova. From a calculation of probabilities Crew² has estimated that at the time of conception the proportion of male to female ova is 170 to 100. We understand neither the reason of this numerical discrepancy in the sexes nor the cause of the relatively high mortality of the male before birth. As Crew has pointed out, it calls for a revision of the criteria upon which we so generally speak of the "stronger sex !"

EARLY DEVELOPMENT OF THE EMBRYO

The earliest stages of the human ovum have not been seen, the youngest ovum described (that of Miller) being already about ten days old. But the process has been observed in several mammalia, and there is a sufficient probability that in the human the essential phenomena are the same.

The fertilised ovum or zygote divides by repeated division into two, then four, eight, sixteen, thirty-two cells, and so on until a little solid sphere of cells is formed, called the *morula* (Fig. 29). From an early stage the central cells are larger than those on the surface. Whilst segmentation is going on fluid gathers in the morula and displaces the heap of larger cells to one pole. The morula now becomes the *blastocyst* (Fig. 30). The heap of cells on the inner wall of the blastocyst is the *embryonic* or *inner cell-mass*, and from this the essential structures of the embryo originate. The outer layer of cells which envelops the blastocyst is the *trophoblast*. It plays no actual part in the construction of the embryo but it has important nutritive functions to subserve.

The cells on the inner surface of the embryonic cell-mass become flattened to form the *entoderm* and this grows round to form a small closed sac within the blastocyst—the *yolk-sac*. Meantime the trophoblast is enlarging more rapidly than the embryonic area.

Whilst the yolk-sac is being formed the inner cell-mass becomes hollowed out by fluid which gathers within it more towards its inner aspect—the cavity thus formed is called the *amniotic cavity*. The cells on the inner aspect of this cavity—i.e. those next the entoderm—become columnar in shape and constitute the *embryonic entoderm*. At this stage the embryo is represented by a small heap of cells attached by a

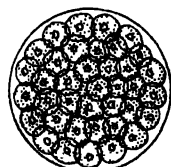


FIG. 29.—Morula
Stage of Ovum.

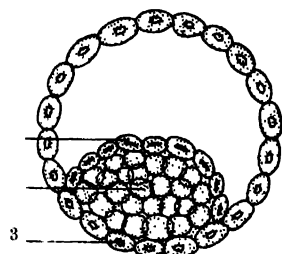


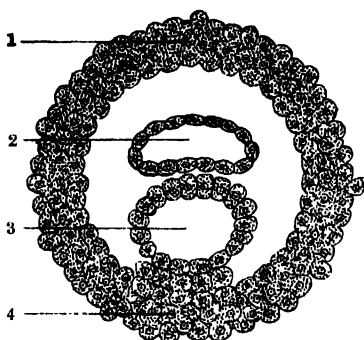
FIG. 30.—Blastocyst.

1. Entoderm Covering.
2. Inner Cell-Mass.
3. Trophoblast.

¹ Schultz, *Contrib. to Embryology*, Carnegie Institution, Washington, U.S.A., p. 56.

² Crew, *Trans. Edin. Obst. Soc.*, 1927, p. 47.

relatively broad base to the inner wall of the blastocyst. The area of attachment is called the *ventral stalk* and is the precursor, as we shall see, of the umbilical cord.



T. H. Bryce, "Quain's Anatomy."

FIG. 31.—Developing Ovum.

1. Trophoblast.
2. Yolk-Sac.
3. Amniotic Cavity.
4. Ventral Stalk

We have thus followed the early origins of the embryonic ectoderm and entoderm. As seen in the lower animals the embryonic area is at this time represented by a circular or oval patch of darker colour on the surface of the blastocyst. At an early stage the hind part of this area becomes darker than the rest and on examination this change is found to be due to the appearance of spindle-cells between the ectoderm and the entoderm. This is the *mesoderm*.

The same spindle-cells then appear all over the embryonic area separating the ectodermic and entodermic layers of the embryo, and at the outer margin of the embryonic area the mesoderm spreads outwards all round, splitting into two layers. One layer grows round to cover the yolk-sac—the *splanchnopleure*. The other extends outwards to cover the inner surface of the trophoblast—the *somatopleure*. This layer becomes incorporated with the trophoblast to form the *chorion*. The structure and function of the chorion will be considered later.

If the dark oval area on the surface of the blastocyst be examined at the stages of development which correspond to the first origin of the mesoderm significant changes will be recognised to be occurring. Extending forward in the middle of the embryonic area from the shaded mesodermic region is a slight depression—the *primitive streak*—on each side of which the cells are raised to form the *primitive folds*. Shortly after this a second mesial groove appears in front of the primitive streak—the *medullary groove*—and this is also bounded by two raised folds, which unite in front and diverge behind. This groove at a later stage closes over to form the neural canal.

As development progresses the embryo projects more and more free into the cavity of the blastocyst, and the ventral stalk, becoming relatively narrower, forms a sort of pedicle from which the embryo dangles.

The details of development of the foetus cannot be described in a book of this scope. Only those sufficient for an understanding of the foetal membranes, placenta and umbilical cord will be given.

The embryo at first lies flush on the floor of the amniotic cavity. At an early stage, however, the amniotic cavity increases and the amnion dipping downwards all round the embryo eventually encloses it completely, or practically completely. As the amnion grows round to fold the embryo off it necessarily constricts off a portion of the yolk-sac; this is left as a tube running the length of the embryo. This tube

is lined by the entoderm which is folded over at the same time. The tube is the *primitive gut* and it communicates with the yolk-sac (Figs. 33-35). As the amnion expands it gradually comes to fill the greater part of the blastocyst. Its outer surface comes up against the mesodermic layer of the chorion, with which it remains in contact up to the end

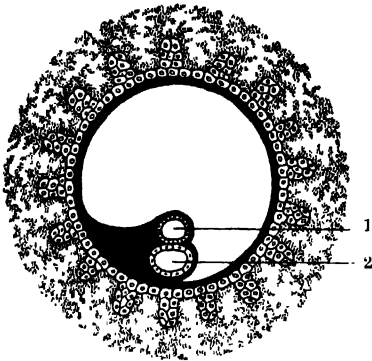


FIG. 32.

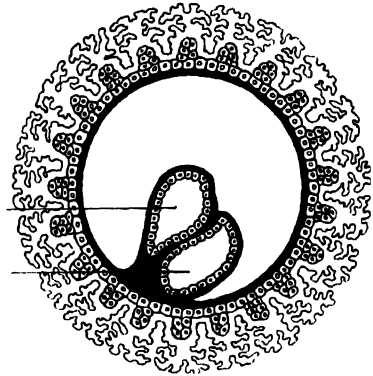


FIG. 33.

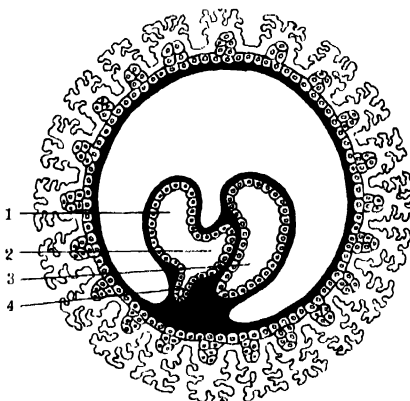


FIG. 34.

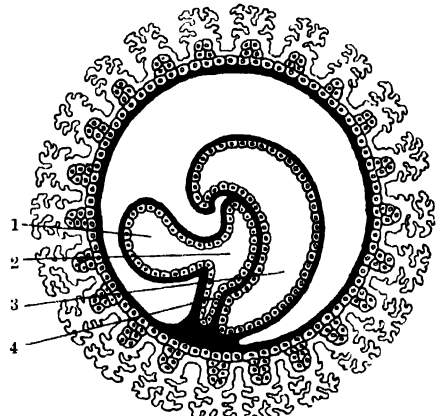


FIG. 35.

These diagrams show the process of "Folding-off" of the Embryo. Mesoderm shaded black. The Yolk-Sac becomes constricted and the Proximal Part forms the Primitive Gut, from the hind end of which the Allantois grows into the Ventral Stalk. (Johnstone.)

1. Yolk-sac. 2. Primitive Gut. 3. Amniotic Cavity. 4. Allantois.

of pregnancy, though even then the two membranes can usually be stripped from one another. A reference to Fig. 34 will show also how, as the amnion comes to fill up the blastocyst, it forms a covering for the ventral stalk. The same figure shows also how, with the folding of the amnion round the ovum, a portion of the primitive coelome becomes nipped off to form a cavity—the coelome—within the ventral aspect of the embryo.

Meanwhile the yolk-sac is shrinking, and eventually it forms a small vesicle in the ventral stalk—the *umbilical vesicle*—communicating with the primitive gut by the *vitelline duct* (Fig. 36).

The ventral stalk possesses another structure of importance—the *allantois*. This is formed from a diverticulum which extends outwards from the hind end of the primitive gut and which burrows along the ventral stalk. In some of the lower animals this structure reaches a large size, extending along the trophoblast to form the placenta. In man it forms the bladder and the urachus.

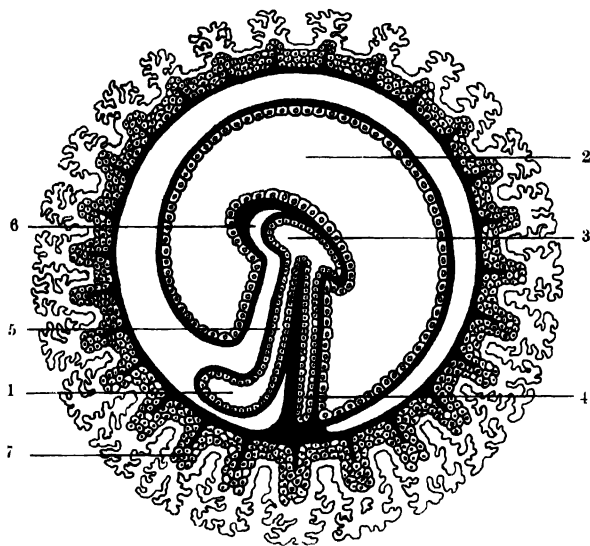


FIG. 36.

- | | |
|-----------------------|-------------------------------|
| 1. Umbilical Vesicle. | 5. Vitelline Duct. |
| 2. Amniotic Cavity. | 6. Chorion. |
| 3. Primitive Gut. | 7. Villus of Trophoblast with |
| 4. Allantois. | Core of Mesoderm. |

The mode of development of the *umbilical cord* will now be apparent. It consists of the original ventral stalk formed of the mesoderm enclosed by the amnion and containing the umbilical vesicle and the vitelline duct and the allantois. In addition, from an early stage, it conveys the umbilical vessels from the fœtus to the chorion, in the mesodermic lining of which they spread out. The umbilical cord at first possesses two arteries and two veins. The veins fuse into one at a later date, so that at birth the umbilical cord possesses ordinarily two arteries and one vein. With development the position of attachment of the umbilicus to the embryo shifts, so that whilst to begin with it is nearer the caudal end, at a later date it takes up a more central position, and this it maintains throughout. The structure of the umbilical cord and its relations to the placenta will be described later.

There are still some points in connection with the *amniotic sac* which require description. This sac is from the beginning filled with

fluid and this fluid increases naturally as the amnion enlarges. At the time when the amniotic cavity fills up the blastocyst it is much larger in proportion than the minute embryo, and this relative difference is maintained for some time. Later, however, the foetus grows at a relatively quicker rate, and at the end of pregnancy it occupies a large part of the cavity.

The remainder of the cavity is occupied by fluid which bathes the foetus all round and in which the growing child can move fairly freely. At the end of pregnancy the quantity of fluid within the amnion is $1\frac{1}{2}$ to $2\frac{1}{2}$ pints. The amniotic fluid is a pale, sterile, straw-coloured alkaline fluid with a specific gravity of about 1010. For a discussion of the functions of the amniotic fluid see Chapter VII.

IMPLANTATION AND IMBEDDING

The earliest stages of implantation of the human ovum in the mucous membrane of the uterus have not yet been seen. It has been computed that about seven days elapse between fertilisation and imbedding, during which period the ovum or zygote is nourished by the secretion from the uterine glands. Much is happening at this period—the ovum is rapidly developing and (under the influence of the sex glands and more especially the corpus luteum (p. 59)) the mucosa of the uterus is preparing itself for the reception of the zygote. A short time after the ovum imbeds the Aschheim-Zondek test (p. 168) begins to be positive. In the youngest segmented human ova so far described, those of Miller, Kleinhans, Young and Linzenmeir, which are probably from ten to twelve days old, the blastocyst in each case occupies a cavity sunk in the endometrium and completely shut off from the surface. The youngest of these ova is that of Miller, which measures 0.83×0.44 mm. and is ten to eleven days old. That of Kleinhans (described by Grosser) measures 0.8×0.65 mm., Linzenmeir's is 1.05×0.9 mm., whilst that of Young is 1.5×0.77 mm. The ovum of Bryce and Teacher (Fig. 37) comes next in succession; its diameters are 1.95×0.95 mm., and it is about thirteen or fourteen days old. These four ova resemble one another in that their blastocysts are still in the smooth, more or less avillous phase.

The fact that in the earliest human ova so far observed the implantation process is already completed necessarily implies that we have no certain means of deducing the exact mechanism by which this process is accomplished. To account for the complete passage of the ovum from the cavity of the uterus into the depths of the mucosa, it was at one time conceived that the ovum, which by this time had reached the morula stage, lodged in a groove in the endometrium, and that the implantation chamber was then completed by a growing over and fusion of the lips of this groove behind the ovum. From this conjectured closing of the implantation cavity by a reflexion of the

endometrium on each side sprang the conception of the *decidua reflexa* (see under). According to a somewhat different view, the necessity for lodgment in a groove was eliminated by supposing that the ovum lying on the flat surface was engulfed by an upgrowth or reflexion of the tissue all round, which eventually fused over the ovum to shut in the implantation cavity. Subsequent investigations have gradually led to a discarding of these views of the mode of formation of the endometrial chamber, and in their stead there has been substituted a mechanism implying a more active rôle on the part of the ovum itself.

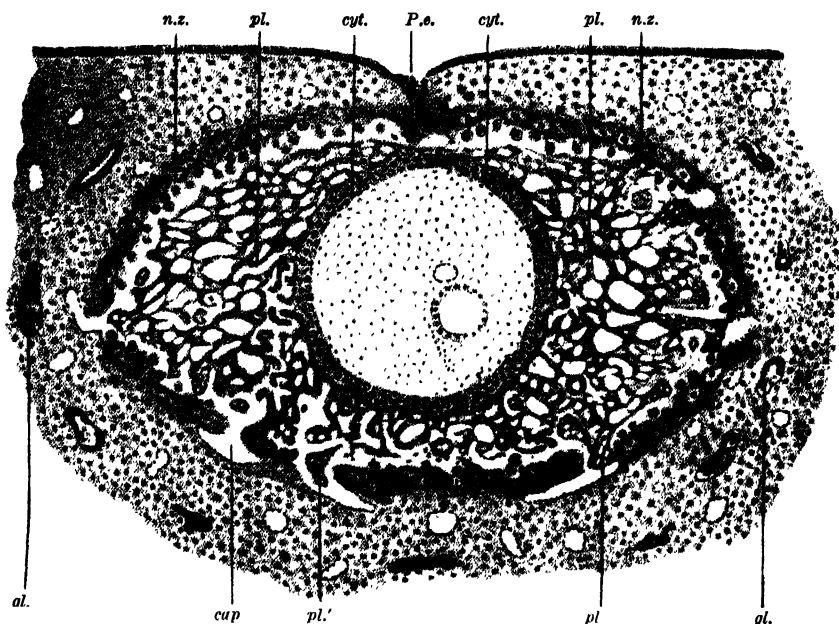


FIG. 37.—Diagram of Teacher-Bryce Ovum. Magnified 50 d. (T. H. Bryce, del.)

P.e., point of entrance; *cyt.*, cyto-trophoblast; *pl.*, plasmodytrophoblast; *n.z.*, necrotic zone of decidua; *gl.*, gland; *cap.*, capillary; *pl.*, masses of vacuolating plasmodium invading capillaries. The cavity of the blastocyst is completely filled by mesoblast, and imbedded therein are the amnio-embryonic and endodermic vesicles. The natural proportions of the several parts have been strictly observed.

Having reached the uterus it is now believed that the zygote, by virtue of the erosive action of its superficial cells (trophoblast), destroys the covering maternal epithelium and excavates for itself a bed in the stroma of the mucous membrane. Whilst the ovum is still lying in the uterine cavity against the epithelium of the mucosa it is probable that the adjacent mucous membrane becomes congested and softened in readiness for the reception of the ovum. Indeed, we now know that under ordinary conditions ovulation occurs round about the middle of the menstrual cycle, and that therefore the fertilised ovum will reach the uterus during the premenstrual or secretory phase, when the endometrium is in the ideal condition for reception of the zygote. In a fertile cycle the premenstrual changes in the endometrium thus become synonymous with changes laid down in preparation for

gestation. Immediately after the covering epithelium is broken through, the congestion of the adjacent tissues becomes more marked and the ovum *now grows inwards* into an area suffused with maternal blood fluid. Probably at once the whole surface of the ovum becomes bathed with the blood poured from the opened-up mother's vessels. It is thus virtually immersed in a number of blood-lakes. The exact nature of these changes is still obscure, but they would seem beyond doubt to be caused by some biochemical material that diffuses into the surrounding tissues from the surface cells, or *trophoblast*, of the ovum. The major changes occur in the immediately adjacent stroma, but the same changes are present in eccentrically lessening degree in the further tissues as well. After the ovum has passed completely into the uterine stroma, the opening through which it entered becomes sealed with blood-clot (Fig. 37, *P.e.*).

From a very early stage the external layer of cells that covers the whole surface of the blastocyst is divided into two strata—the inner or Langhans' cells and the outer or syncytium. The *Langhans' cells* are round or polyhedral cells with a pale body and a well-staining nucleus; they are usually several layers deep. The *syncytium* is composed of a multinucleated plasmodium with no cell outlines, which is spread over the surface of the Langhans' layer in the form of a sheet of soft tissue. It often spreads in masses from the surface of the trophoblast into the maternal tissues and it can often be seen lining the walls of the opened-out maternal blood-sinuses.

In all save the youngest human ova which have been described the trophoblast is already covered by feathery projections from its surface—the *villi*. These are composed of the two epithelial layers that make up the epithelial covering of the trophoblast, and in addition they contain a core of mesoderm derived from the spindle-cells that line the blastocyst cavity. At a later date this connective tissue conveys the foetal vessels into the villi, and in this way the foetal and maternal bloods are brought into intimate relationship. This relationship extends at first along the whole surface of the blastocyst, but later it is limited to the placental area only. It is in this way that the exchange of nutritive and waste materials from and to mother and foetus is maintained. The trophoblast has now become *chorion* and the trophoblastic villi have become the *chorionic villi*.

Whilst these developments are taking place the ovum is enlarging and the cavity in the uterine stroma in which it lies is expanding to keep pace with it. The area of the mucosa, occupied by the ovum, is represented by a minute very congested superficial button of mucous membrane projecting into the uterine cavity.

The mucous membrane all round the ovum is infiltrated deeply by blood-cells and blood-plasma which suffuse the whole trophoblastic area and beyond. These phenomena are very marked in the earliest ova and, by virtue of the increasing size of the trophoblast and the

corresponding increase in the quantity of the biochemical material which it secretes, these changes are present at regions comparatively far removed from the ovum.¹ It is obvious that to control them some protective arrangement is demanded, and for this the *decidua* is formed. This consists of an enlargement of the connective tissue cells of the mucosa, which become closely packed together to form a solid mosaic buttressing the vessels and supporting the mucosa. The *decidual reaction*, as it is called, starts in the vicinity of the ovum, but it soon spreads until eventually the whole of the mucosa of the uterine body is thus changed. The conception of the decidua as we have just given it—namely, that it is a provision intended to save the mucosa from an extensive tearing up of its substance by hæmorrhage and œdema after the needs of the ovum are established—has the advantage of explaining the rationale of the distant deciduæ. For, as we have said, the whole mucosa becomes transformed into a decidua. The biochemical materials produced by the trophoblast enter the blood-stream, and would thus reach and affect the distant regions of the sensitive mucosa unless this were made resistant by the decidual packing of the cells. It is now known that the corpus luteum of pregnancy in the ovary plays some part in determining the decidual reaction of the mucosa. The structure of the decidua is shown in illustration (Fig. 38). The large pale cells are seen to be closely packed together.

In association with the decidual alteration of the stroma-cells, the uterine glands exhibit active proliferative changes. They often become tortuous and form villous-like projections into the lumina. These changes are specially marked in the deeper layer of the mucosa and give this layer a spongy character. It is therefore called the *spongy layer* or *stratum spongiosum*. In the superficial portion of the decidua the enlargement of the stroma-cells is more marked, and this results in compression and disappearance of the relatively few glands in this part. The superficial part of the decidua is therefore more solid than the deeper part, and is called the *compact layer* or *stratum compactum*. The thickness of the fully formed decidua is anything from $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 12 mm.). The cervical mucous membrane does not show decidual changes under ordinary conditions.

Decidua Reflexa or *Capsularis*, *Decidua Basalis* and *Decidua Vera*.—The portion of decidua that covers the ovum and separates it from the uterine cavity is called the *Decidua Reflexa*, or *Capsularis*, so called because formerly, as we have seen, it was at one time believed that this portion became *reflected* up round the ovum as it lay in a depression in the mucosa surface. Thus the term *decidua reflexa* has been displaced by that of *Decidua Capsularis*.

The decidua that lies under the ovum and separates it from the uterine muscle is called the *Decidua Basalis* (the older term *Decidua*

¹ In extrauterine pregnancy the decidua forms in the uterus (p. 346).

Serotina has been given up). The extra-ovular decidua—i.e. that lining the remainder of the uterine cavity—is called the *Decidua Vera*.

As the ovum enlarges the decidua capsularis is pressed further and further against the decidua vera over the greater part of the uterine cavity. The capsularis and vera eventually fuse together and the uterine cavity becomes obliterated. This occurs at about the end of

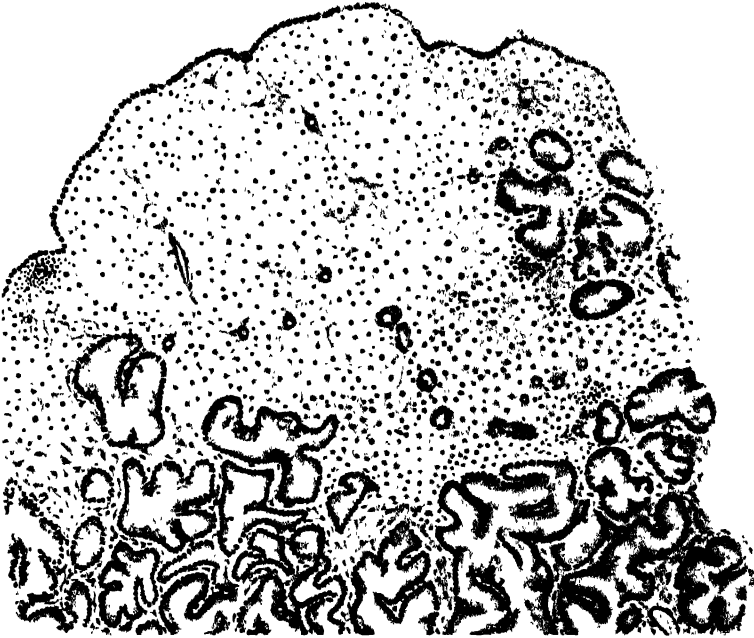


FIG. 38.—Uterine Decidua, showing Stratum Compactum (upper), and Stratum Spongiosum (lower).

the twelfth week of pregnancy. The capsularis and vera from this date atrophy and at full time are represented by thin strands of degenerated decidual tissue.

FURTHER DEVELOPMENT OF THE CHORION— THE PLACENTA—THE UMBILICAL CORD

On the preceding pages we have traced the chorion, to the stage of the early formation of the chorionic villi. These consist in the first place of solid branching buds and oftentimes irregular masses of chorionic epithelium, extending outwards from the surface of the trophoblast into the surrounding maternal blood-lakes. The masses are composed of Langhans' cells, covered by an irregular thickness of syncytium.

Later the solid masses of epithelium become invaded by stalks of mesoblast. These grow outwards from the mesodermic tissue, which

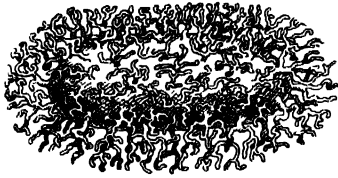
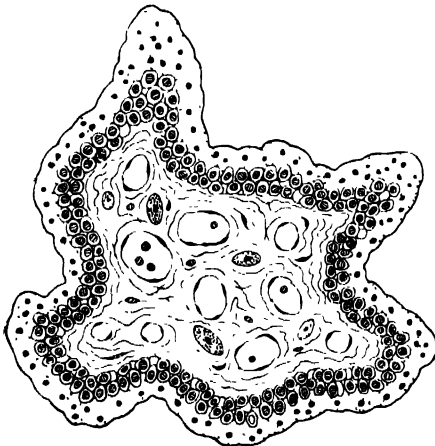


FIG. 39.—Ovum covered all over with Villi.

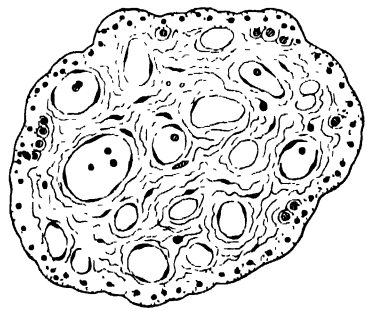
spreads, as we have seen, under the trophoblast from the embryonic area. At a still later date these solid cores of connective tissue, in their turn, become channelled by vessels which become linked up with the umbilical system of the foetus. The villi by this time have become long, tender offshoots from the blastocyst, which branch and divide into

small lateral twigs which lie free in the surrounding blood-lake, except where, at their tips, some are attached to the decidua (Fig. 42). This arrangement allows of the foetal blood as it circulates in the villi being spread out over a large surface of the blastocyst, and renders easy a free interchange between the foetal and maternal circulations. The general arrangement reminds one of the way in which in the lungs the blood is spread out over a large surface in the alveoli to allow of the gaseous interchange that makes for aeration. Across the villi, as they lie bathed in the mother's blood, nutritive matter in solution and oxygen are conveyed to the foetus, and waste gases and other material in solution are carried back from the foetus to the mother. But, as is explained later, the ectodermal cells perform in addition the functions of selecting and altering nutritive material brought by the mother's blood so that it is rendered suitable for the growing embryo.

The structure of a villus at this stage is shown in Fig. 40 (a).



(a) During Early Months.



(b) During Late Months of Pregnancy.

FIG. 40.—Chorionic Villus.

At the end of about four weeks the entire surface of the chorion is covered by villi (Fig. 39), which give it a feathery appearance when the blastocyst is floated in water. From this time the villi over the

blastocyst, except where this lies on the decidua basalis, atrophy and disappear for the most part, though shreds of villi may still be seen in this area late on into pregnancy. Over the decidua basalis the villi continue to grow until term. The portion of the chorion which thus remains active is called the *chorion frondosum* (Fig. 41) in contradistinction to the portion which undergoes atrophy—the *chorion læve* (smooth chorion).

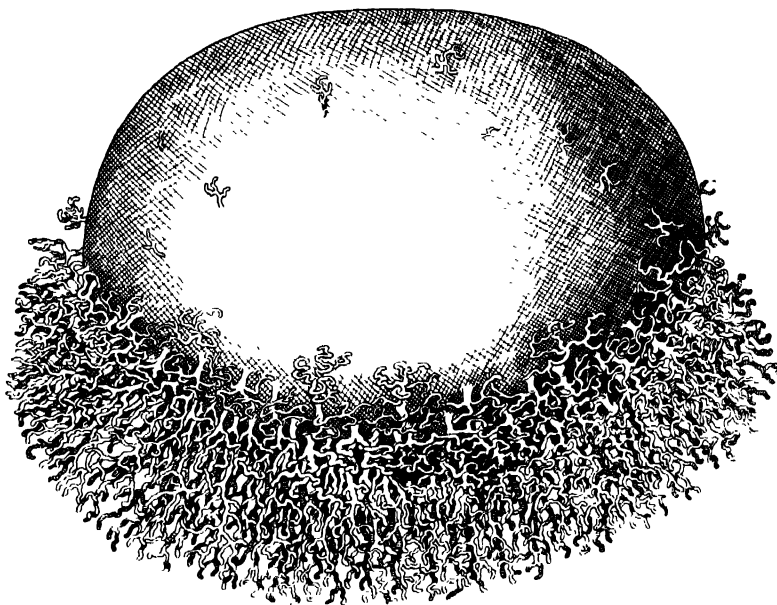


FIG. 41.—Ovum with Villi remaining only over the *Chorion Frondosum*.

The Placenta.—This is developed from the chorion frondosum and from the adjacent decidua basalis. Into its composition there therefore enter foetal and maternal tissues.

In the human the chorion frondosum is shaped like a disc, and the human placenta thus belongs to the *discoidal* class.

Its mode of development will not be difficult to follow if the preceding pages have been carefully studied. We have seen that (*a*) all round the blastocyst a blood-lake was formed in the early stages of imbedding; (*b*) that into this blood-lake the thin-walled maternal arteries opened and poured their blood; (*c*) that after circulating in the lake the blood was conveyed back by the open mouths of the maternal veins; (*d*) that this space was traversed by the villous tufts which sprouted outwards from the chorion, and that some at their ends were moored to the decidua.

The blood-lake is sometimes called the *intervillous blood-space*. From the earliest stage and throughout pregnancy the decidual surface immediately abutting on the blood-lake is degenerated, being

represented by a layer of fibrinous tissue with no cellular outlines—*Nitabuch's layer*.

Over the decidua basalis the villi form complicated, branching tufts and, at points where they are attached to decidua, masses of Langhans' cells and syncytium are often found wandering into the decidua, becoming closely intermingled with the decid-
ual cells. In addition to the villous stalks, which traverse the intervillous space, there are also stalks of decidua which stretch across as pillars to obtain attachment to the surface of the chorion. The intervillous blood-space may thus be likened to a building whose interior is supported by a multitude of pillars. The roof would correspond to the chorion and the floor to the decidua and the pillars to the bridging stalks of villi or decidua. The decidual stalks are much less numerous than the villous stalks. The blood circulates in the intervillous blood-space, entering by the mouths of the arteries, and escapes by the open venous mouths by a process somewhat similar to the movements of a crowd of people who enter our hypothetical building by some doors and, after mingling with one another, leave by

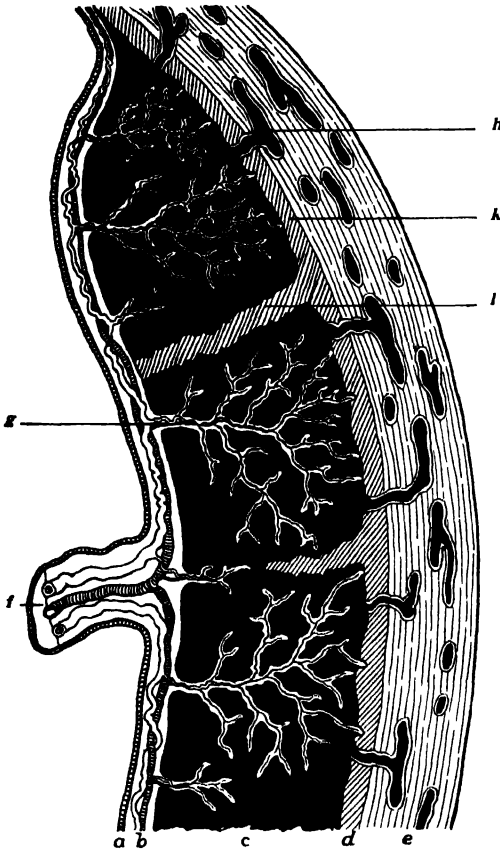


FIG. 42.—Diagrammatic Section of Placenta.

- | | |
|------------------------------------|---------------------------------|
| a. Amnion. | f. Umbilical Cord with Vessels. |
| b. Chorion with Umbilical Vessels. | g. Villus with Foetal Vessels. |
| c. Intervillous Blood-Space. | h. Maternal Vessel. |
| d. Decidua. | i. Decidua. |
| e. Muscular Wall of Uterus | l. Decidual Column |

other doors. But there is a wonderful control at the entrance doors—to continue the metaphor. It has already been stated that the uterine arteries run a tortuous course through the uterine wall. This has the effect of slowing down the blood-stream into the intervillous space. Thus the villi are bathed in a very slowly circulating blood-stream.

If a section of the entire thickness of the placenta be made, the appearances shown in Fig. 42 are seen. The great mass of the section consists of the branchings of the villi, in the core of which the foetal vessels are seen. Here and there masses of decidua may be seen,

formed by the decidual pillars which are cut across. On one side the irregular surface of the chorion is noted, whilst on the other side the uneven, decidual surface is seen. The intervillous space is filled with maternal blood, though during the process of fixation of the specimen this usually diffuses out and the intervillous space seems to be empty.

An examination of the villi will show how, in the placenta, there is nothing intervening between the foetal and maternal bloods except the thin wall of the foetal capillary, the thin layer of villous connective tissue and the one or two layers of chorionic epithelium.

The epithelium of the villi in the early stages is abundant and, as we have seen, has two distinct cellular layers. As development continues the epithelium thins out and at term is represented by an irregular layer of syncytium covering the villi (Fig. 40 (b)).

At labour the placenta becomes detached from the uterine wall at the level of the spongy layer of the decidua. At this level the line of cleavage is easy.

PLACENTA AT TERM (Figs. 43, 44).—At full term the placenta has a flattened circular shape, with a diameter of about 8 inches (20 cm.), a thickness of about 1 inch (2.5 cm.), and weighs a little over a pound.

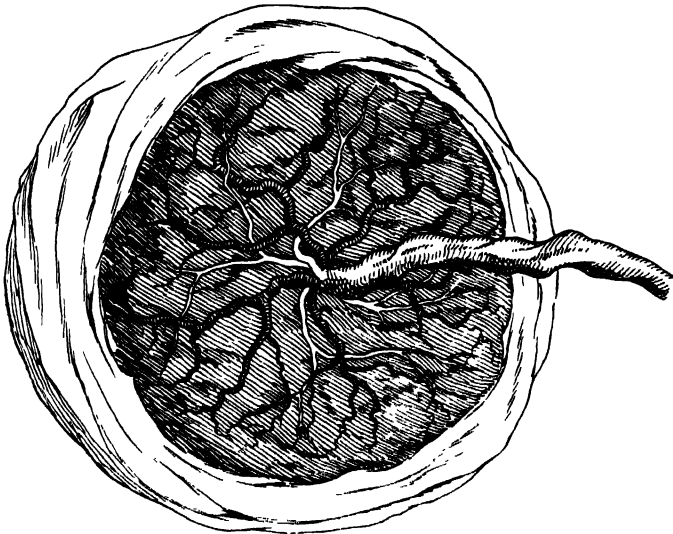


FIG. 43.—Placenta at Full Term—Foetal Surface.

It thins out towards the edges, and at the extreme edge all round the membranes on its foetal surface pass directly on to the uterine wall. The umbilical cord is inserted about the middle of the *foetal surface*. This surface is smooth and shining and is raised in ridges by the umbilical vessels which radiate from the insertion of the cord. The glistening surface is due to the amnion which covers it and which can be stripped from the underlying chorion. The *maternal surface* is furrowed and dark red or purple in colour, and, in the fresh state, blood may be seen

oozing from the torn maternal vessels. When cut into the placenta is found to have a sponge-like consistence.

Occasionally, even in health, patches of solidification ("infarcts") may be seen in the placenta, especially towards the margins; these areas are described later (p. 312). The uterine surface shows very frequently small deposits of lime salts.

The Umbilical Cord.—At full term the cord or funis is about $\frac{1}{2}$ inch (12 mm.) in diameter, but it is often thicker. Its average

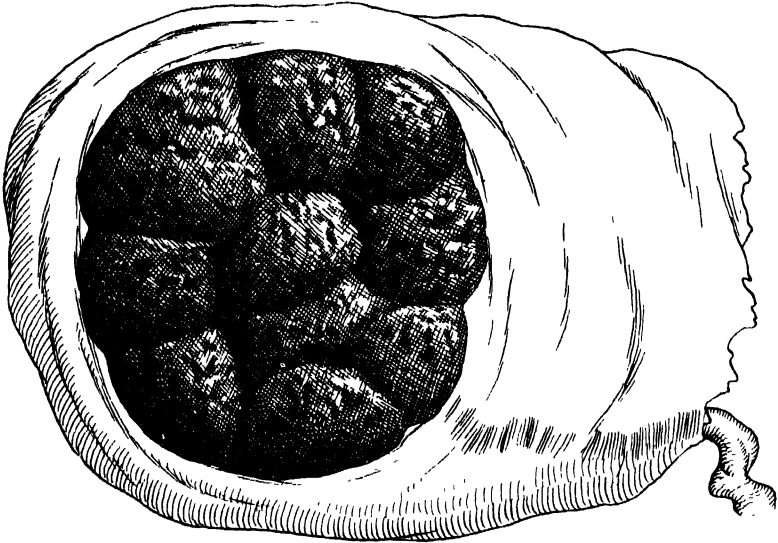


FIG. 44.—Placenta at Full Term—Maternal Surface, showing Cotyledons of Placenta.

length is 20 inches (50 cm.)—*i.e.* about the same length as the child, but this varies greatly. It is inserted generally at the centre of the placenta, but not infrequently near or at the margin, when it is called a *battledore* insertion (p. 503). The cord consists of a covering of cubical epithelium of the amnion, which is continuous at the navel with the epidermis of the foetus. The mass of the cord consists of a very myxomatous embryonic connective tissue, the interstices of which are filled with a jelly-like substance. It is known as *Wharton's jelly*. Early in foetal life there are two veins and two arterics, but the right vein disappears. The remains of the allantois and of the umbilical vesicle may be found in the foetal end of the cord. The cord is usually twisted from left to right.

THE FŒTUS

It is often a matter of considerable difficulty to tell the exact age of an embryo or of a premature infant. There are certain considerations, however, which, when taken in conjunction, provide sufficiently satisfactory data for ordinary purposes. These are the length, the weight and the developmental features.

FIRST THREE WEEKS.—During this stage the characters of the ovum can only be recognised by microscopic examination. Its general features have been given on the preceding pages.

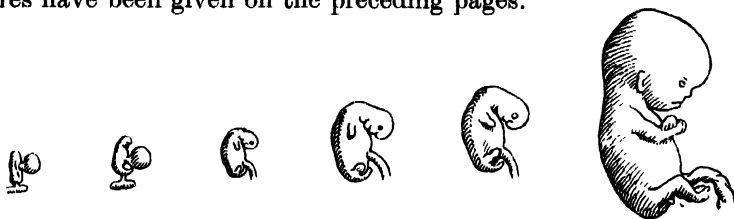


FIG. 45.—Development of the Fœtus in Early Weeks.

END OF FIRST MONTH.¹—The ovum is about the size of a pigeon's egg. The chorion is surrounded completely by villi. The embryo is about 1 cm. long and weighs about 1 gram. It is enclosed in a small amnion, which is separated by a considerable space from the chorion. The embryo is doubled on itself, so that the head and tail almost touch each other. The yolk-sac is still present and the cord is short and thick. The ear and eye vesicles are visible and the buds corresponding to the limbs are distinct.

END OF SECOND MONTH.—The ovum is about the size of a hen's egg. The villi of the chorion have disappeared except over the placental area. The embryo is 3 to 4 cm. ($1\frac{1}{4}$ to $1\frac{3}{4}$ in.) long and weighs about 4 grams. The hands and feet are showing. The external genitals are seen, but sex is not differentiated in them. The centres of ossification have appeared in some bones.

END OF THIRD MONTH.—The ovum is about the size of a goose's egg. The embryo is about 9 cm. ($3\frac{3}{4}$ in.) long and weighs 30 grams. The nose is visible and the placenta is distinct. There is a beginning of sex differentiation.

END OF FOURTH MONTH.—The fœtus is about 16 cm. (6 in.) long and weighs 130 grams. *Lanugo* (downy hair) appears on the skin. The cord is distinct and it exhibits twistings. The decidua vera and the decidua reflexa have become blended and the placenta is well formed. Sex is now distinctly differentiated. Fœtal movements are present and the heart-sounds are heard.

END OF FIFTH MONTH.—The fœtus is 25 cm. (10 in.) long and weighs about 250 grams (8 oz.). The skin is covered with *vernix caseosa*, which is a secretion of the sebaceous glands mixed with epidermic scales. The child, if born alive, makes a few movements.

END OF SIXTH MONTH.—The fœtus is 30 cm. (12 in.) long and weighs about 680 grams ($1\frac{1}{2}$ lbs.). The nails are distinct, there is hair on the eyebrows and, if born alive, the child breathes and may live a short time.

END OF SEVENTH MONTH.—The fœtus is 35 cm. (14 in.) long and weighs about 1100 grams ($2\frac{1}{2}$ lbs.). The pupillary membrane has disappeared. The testicle is in the scrotum in the male child. If born alive, it may live for a few days, and, in rare cases, it may survive.

¹ Months referred to are lunar months.

END OF EIGHTH MONTH.—The foetus measures 40 cm. (16 in.) and weighs about 1570 grams ($3\frac{1}{2}$ lbs.). The lanugo is disappearing, the nose is prominent and the skin is very red. A child born alive may be occasionally reared.

END OF NINTH MONTH.—The foetus measures 45 cm. (18 in.) and weighs about 2650 grams ($5\frac{1}{2}$ lbs.). The subcutaneous fat is more developed, and the child is plumper and the skin is less wrinkled. The skin is red still and the nails are nearly up to the finger-tips. The cartilage of the nose is distinct, but the ears are still very soft. The child has a fairly good chance of surviving if proper care be observed.

END OF TENTH MONTH (full term).—The child measures 50 cm. (20 in.) and weighs about 3200 grams (7 lbs.). First children are, as a general rule, smaller than subsequent ones. The child has hair on the head, both testicles are in the scrotum, and the nails project over the finger-tips. The bladder contains urine and the lower bowel is full of meconium. Its skin is pink and healthy and the body is plump and well covered with fat. It cries at once when born.

Method of Telling Age of Premature Foetus.—A general consideration of the data enumerated above will, in most cases, give sufficiently reliable information. A method based on the length of the foetus at the different months is in common use and, though somewhat rough-and-ready, is sufficiently useful for ordinary purposes. For the first five months it will be noted, from the figures given above, the length in centimetres is obtained by squaring the number of the month; thus the length at the end of five months is $5 \times 5 = 25$ cm. Thereafter the length is the number of the month $\times 5$. Thus the length at the end of the tenth month is $10 \times 5 = 50$ cm. With a knowledge of these data the physician can easily calculate the age of the foetus from the length, and this is the simplest method of determining the age of the foetus.

Full-time children vary greatly in weight, the average, as we have given it above, being about 7 lbs. Anything from 6 to 8 lbs. is common. Occasionally children weighing 10 or 12 lbs. or even more are born, but these large children are rare. Male children, on the average, are slightly heavier than female. In a poorly nourished woman, or a woman suffering from a debilitating disease, the full-time infant may not weigh more than 4 to 5 lbs. In these circumstances the chances of survival are uncertain.

On the average the weight of the children increases in successive pregnancies up to the time when the mother reaches the age of thirty-five.

X-ray Investigation of Fœtal Maturity.—Radiological examination is sometimes of value in the determination of maturity both before and after birth. The foetus cannot be recognised *in utero* until the bones are sufficiently ossified to throw a shadow, when X-rays provide evidence of the existence of pregnancy. On occasion the fœtal skeleton can be recognised as early as the fourteenth week, but in general the sign is not positive until the sixteenth week. At a later stage the

maturity may be determined *in utero* by (a) the state of the centres of ossification and (b) the size of the foetal skull.

The Foetal Circulation (Fig. 46).—*In utero* the foetus obtains its pure blood from the placenta by means of the umbilical vein, which

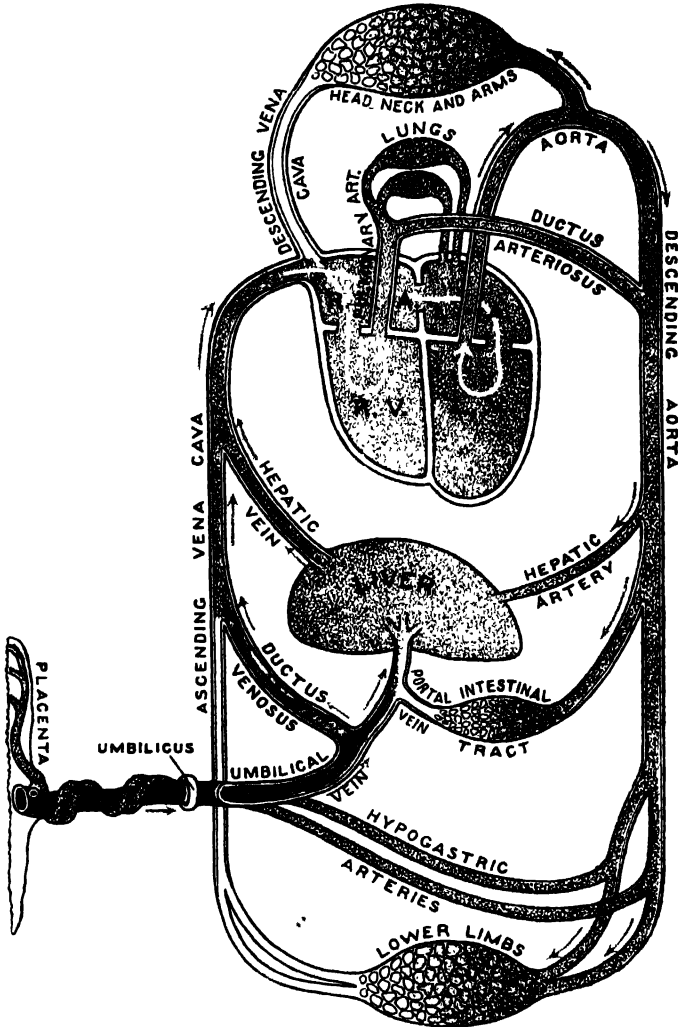


FIG. 46.—Schematic Diagram of the Foetal Circulation.

enters the body at the umbilicus. The impure blood is carried from the foetus to the placenta by means of the two umbilical arteries, which are branches of the two internal iliac arteries. In the placenta the chemical and gaseous exchanges occur which lead to an aeration of the impure blood and to a passing over from the maternal circulation into the vessels of the villi of the food substances in solution required

for the nutrition of the foetus. But we must consider the circulation in the foetus itself.

In utero there is practically no pulmonary circulation, as the functions of the lungs are carried on by the placenta. A certain limited circulation of blood, however, does occur in the lungs for their nutrition and growth.

The foetal heart drives the blood along the umbilical arteries to the placenta. The greater part of the purified blood returning by the umbilical vein is emptied by the *ductus venosus* into the inferior vena cava. The ductus venosus is the main branch of the umbilical vein in the abdomen of the foetus. The other smaller branch empties into the portal vein and along this some of the pure blood passes to supply the liver. From the inferior vena cava the pure blood enters the right auricle. The inferior vena cava has, of course, some impure blood coming from the lower limbs and the body below the diaphragm, and this mingles with the pure umbilical blood. The mixed blood is directed by the *Eustachian valve* through the *foramen ovale* into the left auricle. Thence it enters the left ventricle, and from this it is driven into the aorta. Part goes to the head and neck and upper limbs; the rest is carried downwards. From the head and neck the impure blood returns by the superior vena cava to the right auricle. Thence it enters the right ventricle, which drives it along the pulmonary artery. A small amount of it enters the lungs, but the bulk is short-circuited past the lungs by another foetal structure—the *ductus arteriosus*—which carries it into the aorta.

In the aorta this blood mixes with the blood which has already entered it from the left ventricle in the way described above. Passing down the aorta some of the mixed blood is carried to the lower limbs and the body-wall, but the bulk of it passes into the umbilical arteries *en route* for the placenta.

From the above description it will be evident that the head and upper part of the foetus is supplied with much purer blood than the lower parts. In the later months the Eustachian valve separates the streams less completely, and so the upper part is supplied with blood of lessening purity.

At birth a very complete and sudden change takes place. With the first respiration of the child the lungs are expanded and the blood which passed through the ductus arteriosus is directed to the lungs. The ductus arteriosus soon becomes obliterated, as do the umbilical arteries and the ductus venosus. The foramen ovale takes longer to close and occasionally remains permanently patent.

Some observers have challenged this, the generally accepted description of the foetal circulation. In the first place they contend that there is a considerable admixture of the pure and impure currents in the right auricle and that, in the second place, the closure of the ductus arteriosus and the foramen ovale is a slow process, occupying it may be many weeks. The recent observations of Barcroft and his co-workers,¹ however, have confirmed in the foetal lamb the accuracy

¹ *Brit. Journ. Radiol.*, 1939, vol. xii., p. 505; *Amer. Journ. Anat.*, 1941, vol. lxix., p. 383.

of the classical description. This they have done by injecting thorotrast into the umbilical vein and the superior vena cava and tracing the currents by radiography. Whilst there is some mixing of the two currents, namely, that from the superior and that from the inferior vena cava, these currents are maintained for the most part separate. Their radiographic observations also demonstrate that within a few minutes of birth there is a complete sphincteric-like closure of the ductus arteriosus. Barcroft and his co-workers have confirmed these findings by a comparison of the oxygen content of the bloods in the umbilical vein and the carotid artery.

THE FIRST BREATH.—Barcroft and his co-workers have investigated the mechanism of the first breath. By exposing the foetal lamb in the amniotic sac they found that at the end of the first month of intra-uterine life stimulation of the skin supplied by the maxillary branch of the trigeminal nerve caused action of the respiratory muscles. Later this response is inhibited by the forebrain and this inhibition operates throughout the remainder of intrauterine life. At birth the stimuli to the face and the rest of the body and the secondary stimuli induced in the respiratory tract, chest wall and diaphragm by the first breath initiate the full respiratory responses, whilst at the same time the inhibitory action of the forebrain is depressed by the temporary asphyxia (p. 617).

DEVELOPMENT OF THE REPRODUCTIVE ORGANS AND DEVELOPMENTAL ABNORMALITIES OF THESE ORGANS

DEVELOPMENT OF THE REPRODUCTIVE ORGANS

THE FEMALE GENITAL TRACT.—This tract is developed mainly from the Müllerian ducts, which make their appearance in the embryo by the sixth week of intrauterine life. By that time the structures at the caudal extremity have assumed definite form. As we see in Fig. 47, the alimentary canal and the allantois, from which a part of the primitive bladder is developed, open into a cloaca, which is closed over by the cloacal membrane. This cloaca soon divides by lateral shelves into two portions, the dorsal of which forms the rectum, while the ventral forms the urogenital sinus. The Wolffian ducts, which play a minor part in the development of the reproductive organs in the female, but which are of great importance in the male, open into the urogenital sinus; and,

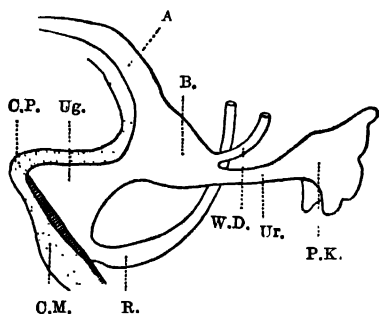


FIG. 47. — Diagram of Urogenital Sinus, Ducts, etc., in an Embryo of about 11 mm. C.P., Cloacal Papilla; Ug., Urogenital Sinus (Phallic portion); C.M., Cloacal Membrane; B., Primitive Bladder; W.D., Wolffian Duct; Ur., Ureter; P.K., Pelvis, Kidney; R., Rectum; A., Allantois. (Bryce.)

from the lower ends of the Wolffian ducts there pass, upwards and backwards, the diverticula which are to form the ureter, pelvis, calices and collecting tubules of the permanent kidney. These diverticula soon acquire separate openings into the sinus; and, as the sinus grows to form the rest of the bladder, the openings of the Wolffian ducts remain anchored close together, while the openings of the ureters are drawn upwards and apart in the formation of the trigone of the bladder (Figs. 47, 48).

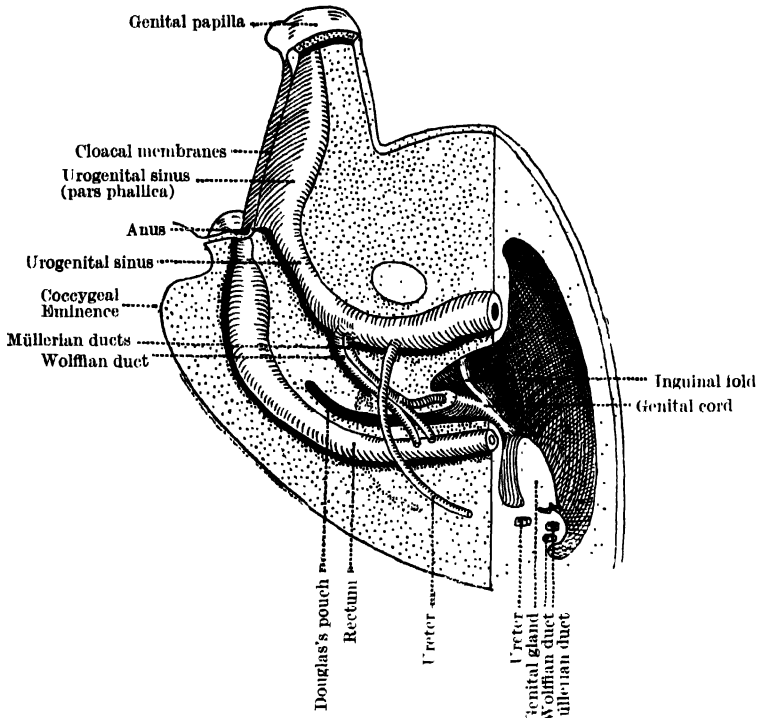


FIG. 48.—Urogenital Sinus, Rectum, Ducts, etc., in an Embryo of 28 mm.
Drawn from Keibel's Model.

The Wolffian Body.—In the thoracic region of the early embryo there will be found on the dorsal surface of the coelom, on each side of the middle line, a mass containing a number of tubules, the mesonephros or Wolffian body (Figs. 49, 50). These tubules pass into a longitudinal duct—the Wolffian duct, which passes backwards, to open into the urogenital sinus. Lateral to the Wolffian duct will be found on each side the Müllerian duct, which opens from the coelomic cavity by a funnel-shaped opening, afterwards identifiable as the abdominal ostium of the Fallopian tube (Fig. 51). Accessory ostia originate at this stage of development.

The Broad Ligament.—The Wolffian and Müllerian ducts pass caudalwards in a fold of coelomic lining or peritoneum known as the

genital cord. On approaching the site of the future pelvis, this fold passes inwards towards the middle line (Fig. 51) ; for a short distance its free edge passes horizontally across, to fuse with its fellow of the opposite side. There is thus formed a transverse septum across the

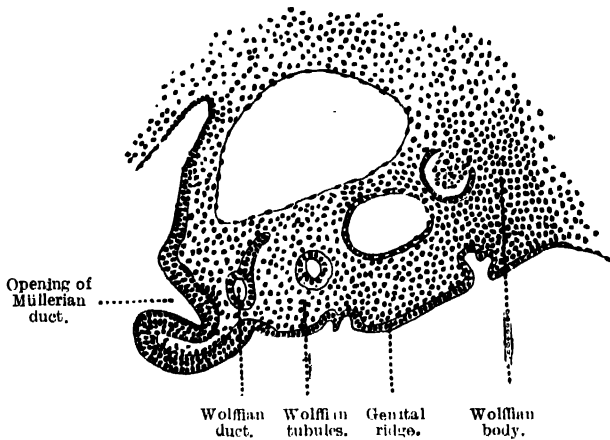


FIG. 49.—Transverse Section of the Urogenital Fold of a Human Embryo of 11 mm. (Felix.)

lower part of the body cavity, to be recognised later as the *broad ligament* (Figs. 51, 52). Just where the fold turns inwards, it is crossed by another fold of peritoneum containing connective tissue, and passing from the inguinal region upwards towards the dorsal region. This

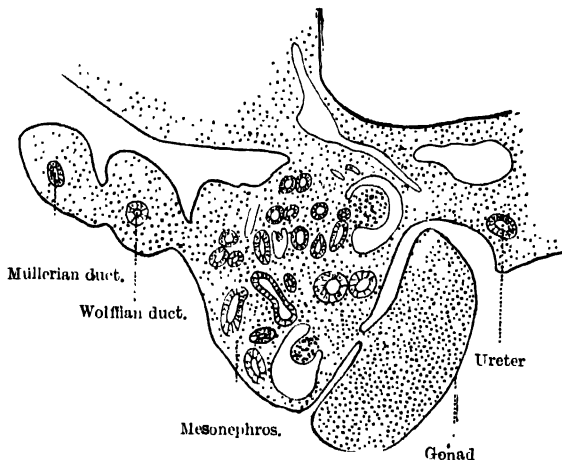


FIG. 50.—Cross-section of the Urogenital Fold in a Human Embryo of 30 mm. (Bryce.)

latter fold, the gubernaculum, can be identified later in two portions : (a) the round ligament, lying between the inguinal canal and the anterior tubo-uterine angle, and (b) the ovarian ligament between the posterior tubo-uterine angle and the lower pole of the ovary.

In the first part of their course, the Müllerian ducts lie lateral to the Wolffian ducts in the free edge of their mesentery. As they reach the pelvic region, however, the folding inwards of the mesenteries brings the Müllerian ducts close together in the middle line, the Wolffian ducts then lying external to them (Figs. 50, 51). Before uniting, the Müllerian ducts run for a short distance transversely across the body cavity; then, as they pass downwards in the middle line, the ducts fuse, and the mesial septum between them disappears, leaving the primitive utero-vaginal cavity. The most distal parts of the ducts do not even become canalised at this stage, but go on growing towards the roof of the urogenital sinus, on which they form an eminence, the Müllerian eminence (Fig. 54). By the eventual canalisation of this group of cells is formed the distal part of the vagina.

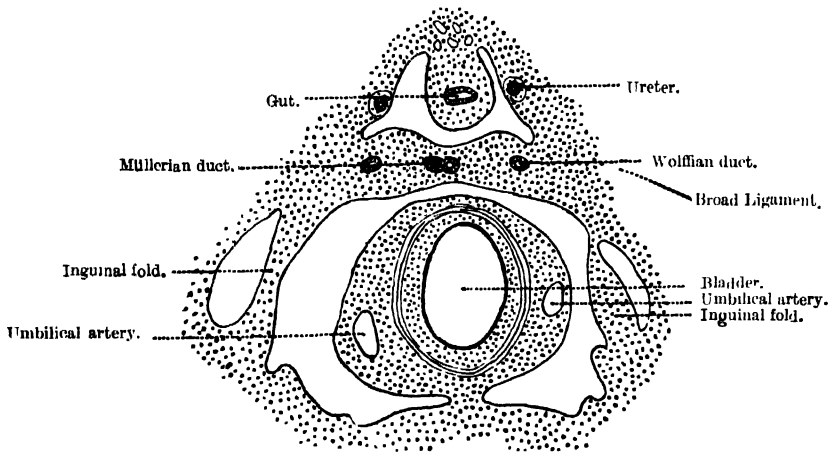


FIG. 51.—Section of the Genital Cord in a Human Embryo of 30 mm. (Bryce.)

The Walls of the Tract.—So far, we have dealt with the epithelial tubes only, but these are surrounded by mesenchyme, or embryonic connective tissue, which is arranged in layers to give muscular or connective tissue coats, the thickness varying at different levels in the tract.

The proximal parts of the Müllerian ducts, with their cœlomic openings, down to the point at which they cross the gubernaculum, form the Fallopian tubes with their abdominal ostia. The layers of mesenchyme surrounding this part of the tract are less thick than in those at a lower level, with which we have now to deal.

The Body of the Uterus.—The mesenchyme in the distal part is very thick, and covers not only the vertical common duct, which represents the future cervix, but also the transverse portions of the ducts as far out as the gubernaculum. The cavity thus enclosed is originally T-shaped (Fig. 52). The horns enlarge, and are taken into the cavity of the uterus, so that the lumen becomes triangular in the frontal plane. The greater portion of the body of the uterus is thus developed from the

separated portions of the ducts—*i.e.* is of tubal origin. At this stage the fundus is depressed or angular. As the tubes open out, the upper wall between them becomes flat, and then, by further upward expansion, convex. The cervix uteri and vagina are the only parts of the tract produced by a fusion of the original epithelial Müllerian ducts. Lateral to the dense mesenchymatous coat surrounding the epithelial tubes, we have the thinned-out broad ligament stretching to the pelvic wall.

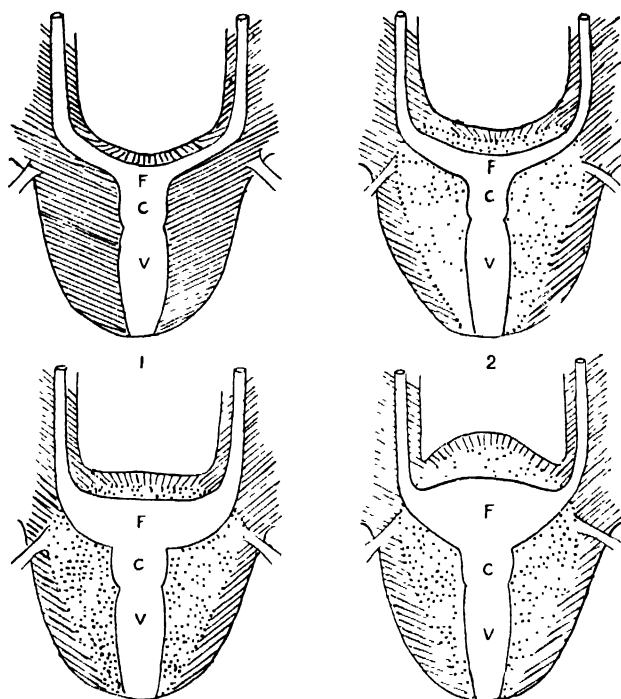


FIG. 52.—Diagrams of Four Stages in the Development of the Genital Tract. (Felix.)

V, Vagina; C, Cervix; F, Body of Uterus. 1. The Müllerian Ducts are shown surrounded by the embryonic connective tissue of the urogenital folds. 2. The stippled area represents the thickening of the Mesenchyme (primitive connective tissue), which will give rise to the Walls of the Body of the Uterus, the Cervix and Vagina. 3. The Primitive Uterine Horns are seen enlarged, and in 4 opened out to form the Cavity of the Uterus. The hatched areas in 3 and 4 on each side of the Uterus represent the Primitive Broad Ligaments. The Round Ligaments are represented in each figure.

The development of the muscular wall of the uterus is very complex because of the inclusion of these ununited portions of the Müllerian ducts in the body of the uterus. The circular muscular coat of each duct becomes stretched out obliquely over the body of the uterus, and the whole arrangement of the muscle bundles in the uterine wall becomes very irregular. The circular fibres round the ducts are primary—the longitudinal fibres appear later. The muscular coat of the cervix is continuous with that of the vagina.

Descent to the Pelvis.—Though the mesonephros lies originally in

the thoracic region, the greatest amount of body growth thereafter takes place at the cephalic end. The extent to which these tubular

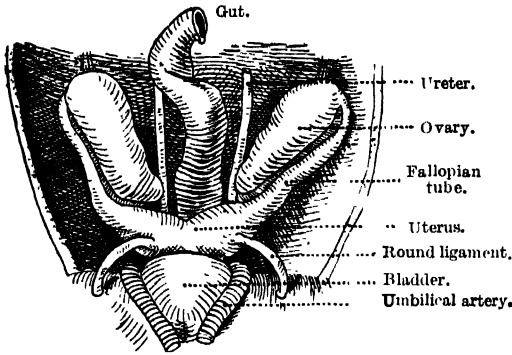


FIG. 53.—Genital Tract in a Female Fœtus of 7½ cm. (Kollmann.)

or duct systems increase in length is not proportional to the increase in length of the body. Consequently, the mesonephros and its associated structures, the Wolffian and Müllerian ducts, come to lie nearer and nearer to the caudal extremity. From a temporary position in the lumbar region, they come eventually to lie entirely inside the pelvis. With the broadening of the

pelvis, the distal portion of the Fallopian tube comes to lie quite transversely in the pelvis (Fig. 53).
The Fate of the Wolffian Duct.—In the female, the Wolffian duct disappears functionally, but it can still be identified as a rudimentary tubule running parallel to the Fallopian tube and below it, between the layers of the broad ligament.

Some short transverse tubules, at right angles to this long tubule, described, according to their position from without inwards, as Kobelt's tubes, the epoöphoron or the paroöphoron, are also found between the layers of the broad ligament and represent persistent collecting tubules of the mesonephros. In exceptional cases the distal end of the Wolffian duct can be traced as Gärtner's duct, through the broad ligament to the uterus just above the cervix, whence it descends in the vaginal wall to end at the level of the hymen (Fig. 407, p. 1014).

Formation of the Vagina.—Returning to the study of the development of the vagina, we find the ends of the Müllerian ducts forming the Müllerian eminence on the dorsal surface of the urogenital sinus (Fig. 54). This group of cells continues to grow distalwards, travelling along the dorsum of the sinus. The canalisation of this mass proceeds from the

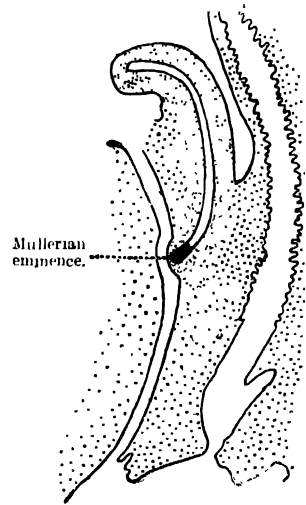


FIG. 54.—Diagrammatic Sagittal Section of the Urogenital Sinus, Genital Tract, and Rectum in a Human Fœtus of 4.5 cm. (third month). (Bayer and Kollmann.) The Müllerian Eminence is seen projecting into the Urogenital Sinus, and is occupied by a solid cord of Epithelium derived from the ends of the Müllerian Ducts. This will form the Vagina.

uterine cavity, and extends into the walls in such a way as to carve out the fornices and round off the vaginal portion of the cervix (Fig. 56). As the Müllerian eminence travels downwards (Fig. 55), the portion of the sinus proximal to it becomes converted into urethra. Eventually there is only a double layer of epithelium between the vaginal cavity, now well hollowed out, and the most distal portion of the urogenital sinus. This septum is the hymen, the perforation of which establishes communication between the lower portion of the genital tract and the urogenital cleft. Should this septum persist, the menstrual discharge would be retained within the genital tract when puberty occurs.

In the foetus the vagina is longer than the uterus, and the cervix longer than the body of the uterus (Fig. 57). Not until about the tenth year is this relationship disturbed: then the body of the uterus begins to grow more rapidly, and when puberty occurs, forms two thirds of the bulk of the organ.

Development of the Ovary.—The gonad makes its first appearance in both sexes as a thickening of the coelomic epithelium on each side of

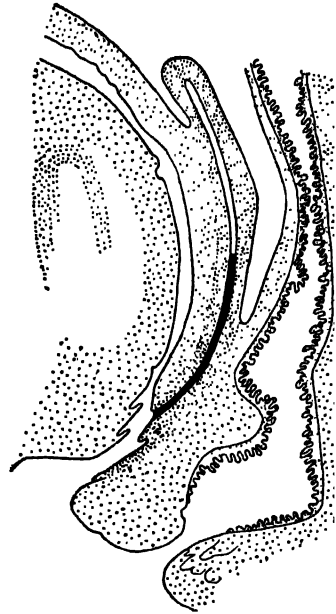


FIG. 55.—Diagrammatic Sagittal Section of the Urogenital Sinus, Genital Tract, and Rectum in a Fetus of 11 cm. (fourth month). (Bayer and Kollmann.) The solid cord of Epithelium representing the future Vagina is now greatly elongated, and Muller's Eminence is now placed much nearer the opening of the Urogenital Sinus.

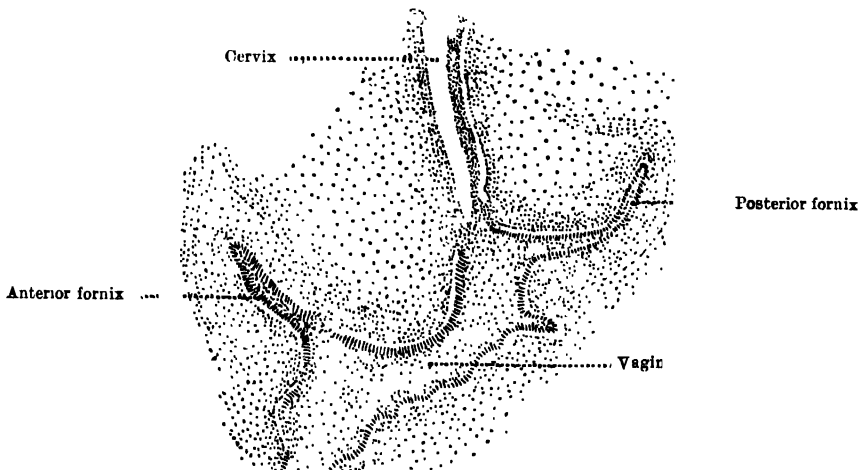


FIG. 56.—Cervix (Portio Vaginalis) and Fornices of Vagina in a Fetus of 28 cm. (sixth month) maximum length. (Marocco and Hollmann.) The Lumen of the Vagina is beginning to form by shedding of the Central Cells of the Primitive Solid Cord.

the middle line at the level of the mesonephros (Figs. 49, 50). This thickening is known as the genital ridge. The proliferation of epithelium and of the mesodermal tissue below give rise to a very prominent ridge which in course of time comes to have a definite mesentery. At first the gonad is indifferent—one cannot tell whether the sex is going to be male or female. The epithelial and mesodermal cells, proliferating in opposite directions in the form of columns, become intimately interlocked. By the third month the gland has assumed the characters of an ovary. On the coelomic surface of the ovary the cells become organised into a single epithelial layer—the germinal or capsular epithelium, underneath which can be identified, by the

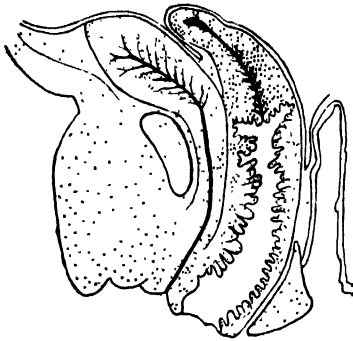


FIG. 57.—Sagittal Section of the Bladder and Urethra, Uterus and Vagina in a Fetus of the seventh month. (Nagel.) The disproportion between the Cervix and Corpus Uteri, which is distinctive of the Fœtal Uterus, is well brought out.

sixth month, a layer of mesodermal cells forming the tunica albuginea. The further development of the component parts of the ovary has already been dealt with in the section on Anatomy (p. 25).

Descent of the Ovary.—While these changes have been going on in the structure of the ovary, the whole organ has been undergoing the same change in position as the other structures which appeared in the thoracic region during the second month—*e.g.* the mesonephros. The ovary approaches nearer and nearer to the pelvis, until it eventually lies in the pelvis. It is not certain how far the descent may have been influenced by the action of the gubernaculum with its contained muscle fibres, which passes from

the inguinal region to the lower pole of the ovary. We find the ovary eventually on the posterior surface of the broad ligament, anchored to the uterus at its posterior tubo-uterine angle by the ovarian ligament, which we remember as the proximal portion of the gubernaculum.

FORMATION OF THE PERINEAL BODY.—The anal opening is produced at a rather later date than the urogenital. The aperture is formed at the bottom of a shallow ectodermal depression, which forms the lower part of the anal canal. The accumulation of connective tissue between rectum and urogenital sinus constitutes the primitive perineal body, and this, with little alteration beyond the increase of tissue, becomes the permanent perineal body.

THE EXTERNAL ORGANS OF REPRODUCTION.—The most distal portion of the body cavity is gradually enclosed by the growth, from the dorsal region on each side, of sheets of mesoderm and muscle which pass ventralwards like the sides of a barrel and fuse in the middle line to form the anterior abdominal wall. The lower extremity of the wall

is raised up as a fold of skin to form the cloacal papilla (Fig. 47). The lower extremity of the dorsal surface can be recognised as the coccygeal eminence (Fig. 48).

Between these two prominences there is a cleft—the urogenital cleft—bounded on each side by the lower edges of these lateral sheets of mesoderm and muscle, and closed below by the thin cloacal membrane. This membrane forms the floor of the urogenital sinus anteriorly, and, when the rectum has become separated off dorsally, forms posteriorly the anal membrane, which still closes over the distal end of the rectum.

The urogenital sinus extends into the cloacal papilla (Fig. 48), which

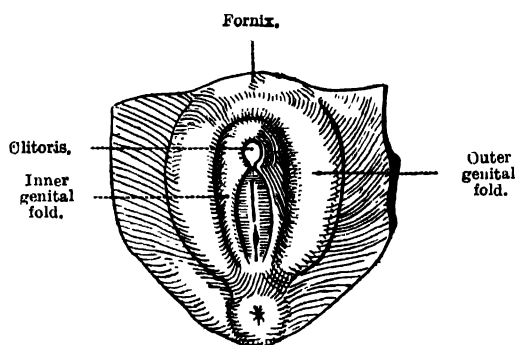


FIG. 58.—Early stage in the development of the External Genital Organs. The Outer Genital Folds become the Labia Majora; the Fornix between them the Mons Veneris; the Inner Genital Folds become the Labia Minora; between the Labia Minora is the opened-out mouth of the Urogenital Sinus (vestibule), into which now open separately the Sinus (urethra) and the Vagina. The Inner Genital Folds meet behind in the fold afterwards the Fourchette, and the Outer Genital Folds merge posteriorly in the primitive perineal body. (Bryce.)

now becomes much thickened by the growth of mesodermal tissue, and forms the genital papilla (Fig. 48), eventually to be identified as the clitoris. Round the base of the genital papilla, too, mesodermal thickening gives rise to a definite fold on each side, the outer genital fold, or precursors of the labia majora, which unite in front of the papilla to form the eminence of the future mons veneris (Fig. 58).

The floor of the urogenital sinus which has extended forwards along the under surface of the genital papilla (Fig. 48) breaks down about the sixth week, allowing free communication between the sinus and the amniotic cavity. As the papilla grows in length, this opening comes to be placed at its base, and a groove extends forwards along its under surface. In the female the lips of this groove and the margins of the opening grow to form the inner genital folds or labia minora; whereas, in the male, the groove forms the dorsal wall of the penile urethra.

The lower end of the vagina is still, at this stage, placed some distance

from the surface, and projects into the urogenital sinus higher up (Fig. 54). As the end of the vagina continues to grow distally towards the urogenital cleft (Fig. 55) it converts the upper portion of the sinus into the urethra; but eventually the end of the vagina arrives at the surface of the cleft. Finally the two passages, urethra and vagina, by the expansion of the sinus mouth, come to open separately on the vestibule of the vagina.

MALFORMATIONS OF THE REPRODUCTIVE ORGANS

The malformations of the reproductive organs are dealt with here because it is obviously the most suitable place to consider them.

The clinical importance of the various types of malformations varies very much. The most extreme degree of deformity, for example *the uterus defectus*, may be associated with no symptoms. Similarly, extreme duplication as in *uterus didelphys* is by no means incompatible with a normal pregnancy and labour. Generally speaking it will be found that it is the slighter variations from the normal which cause the most disturbance.

THE OVARIES

Congenital absence of the ovaries, except in association with some such gross monstrosity as *acardia*, is seldom found. Supernumerary ovaries have been described, but these sometimes admit the explanation of being portions of ovarian tissue which have become separated off from the main organ in the course of its descent into the pelvis.

Displacement of the ovaries may be due to the whole gland being anchored on the posterior abdominal wall before it reaches the pelvis, or to the passage of the ovary into a hernial sac.

THE UTERINE OR FALLOPIAN TUBES

These are seldom completely absent. Their development may be incomplete, resulting in great tortuosity of a small thickened tube. The most common abnormality is the presence of supernumerary ostia due to the formation of accessory funnels from the *cœlomic* cavity into the Müllerian duct in the second month of intrauterine life (p. 90). There may be several such ostia on one tube. There may be diverticula in the wall of the tube, reaching far into the substance of the wall, and these have an important bearing on the *ætiology* of tubal pregnancy.

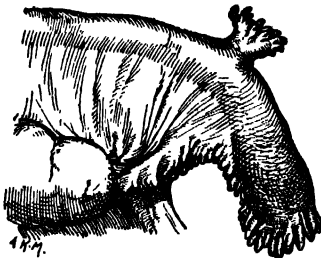


FIG. 59.—Fallopian Tube with Supernumerary Ostium.

BODY OF THE UTERUS

These malformations may be due either to (a) *irregular development of the mesenchymatous coat into the muscle and connective tissue of the uterine wall*, (b) *to variations in the course and fusion of the Müllerian ducts themselves*.

(a) **ABNORMALITIES DUE TO DEFECTIVE DEVELOPMENT OF THE CONNECTIVE TISSUE AND MUSCULAR WALLS OF THE GENITAL TRACT.**—While congenital absence of the uterus is rare, the *uterus defectus* represents a type where there may be only a small nodule of fibromuscular tissue without perhaps any epithelial lumen in its centre. Such irregularities may be associated with obliteration of portions of

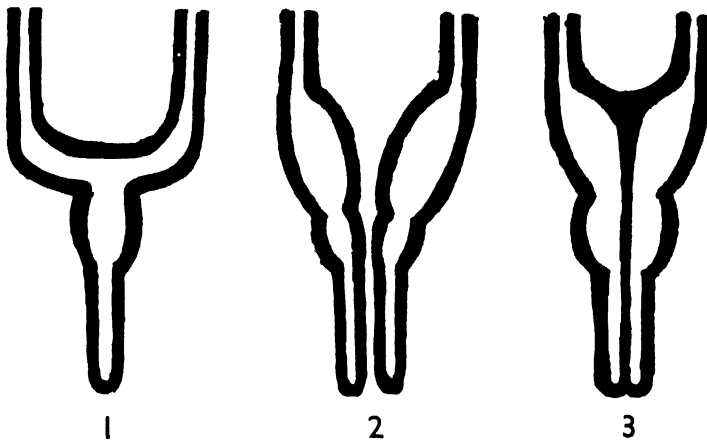


FIG. 60. Diagram to illustrate the Malformations due to Inhibition of Development of the Epithelial Ducts of Müller. 1 represents the normal arrangement in an early Embryo. 2 shows the result of complete separation of the Ducts (Uterus Didelphys). 3 shows the result of a primary separation with later secondary fusion of the Medial Walls of the Ducts (Uterus Septus).

the Müllerian ducts, as, for example, where a tiny uterine body has lost its connection with the vaginal vault, owing to the loss of the cervical portion of the ducts. Where there is no epithelium, there will be no secretory activity, and the patient will be free from the symptoms associated with retention of secretions.

In the *uterus rudimentarius* the muscular wall may be very poor, but the epithelial tubes are intact. The *uterus foetalis* represents the persistence of the proportions of the uterus as usually seen at birth. The cervix comprises two-thirds of the organ, and the whole organ is very small and is generally retroposed with the small body ante-flexed on the longer cervix. Menstruation is generally absent, and there is seldom any dysmenorrhœa. The *uterus pubescens* approaches very closely to the normal organ. Its length may be normal, but it is often narrow and may be acutely ante-flexed (cochleate uterus, p. 859).

The pathological circumstances in this type, as it acted before puberty, might possibly have been preventable had better nutritive and hygienic conditions been present. The condition is usually associated with scanty irregular menstruation, dysmenorrhœa, and sterility. The cervix may appear full-sized ; but the body is often small.

If either of the first two conditions gives rise to extreme dysmenorrhœa, the rational treatment is hysterectomy, as the uterus can never exercise its normal functions. In the third condition, *uterus pubescens*, where the variation from the normal is slight, pregnancy may supervene. In this type of case attempts should be made to stimulate growth by means of tonics, electrical treatment, administra-

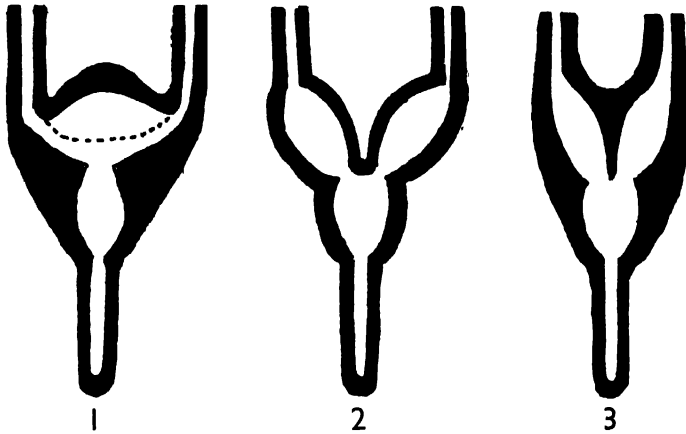


FIG. 61.—Diagram to illustrate the Malformations due to Inhibition of Development of the Epithelial Ducts of Müller. 1 represents the normal condition in which, by a rising of their upper walls, the horizontal portions of the Ducts are taken into the Uterine Cavity. 2 shows the result of Inhibition of this Process (Uterus Bicornis). 3 shows the effect of the Fusion of the Medial Walls of the Separate Horns (Uterus Subseptus).

tion of suitable hormones, to bring if possible the uterus up to the condition of a fully functioning organ ; but frankly the results are generally disappointing (p. 765).

(b) **ABNORMALITIES DUE TO DEFECTS IN THE FUSION AND DEVELOPMENT OF THE MÜLLERIAN DUCTS.**—Such cases differ further in whether the disturbance of development took place (I) at the time of their first appearance, or (II) in the course of their subsequent differentiation. Into Group I fall the cases in which the epithelial ducts have remained separate throughout their entire length. The final result depends upon the degree of separation, and the space afforded thereby for the formation of distinct muscular and connective tissue coats round the two tubes. Into Group II fall the cases in which duplication is confined to the body of the uterus. The body of the uterus is formed from the horizontal ununited parts of the Müllerian ducts (p. 93). The distal

ends of the primitive tubes open up to form the cavity of the uterus and their upper walls rise to form the fundus. If the primitive tubes or horns are placed at an abnormally acute angle to one another, there



FIG. 62.—Uterus Pseudodidelphys.



FIG. 63.—Uterus Bicornis Bicollis.



FIG. 64.—Uterus Bicornis Unicollis.

is not space enough left between for the rising of the medial walls to form the fundus and so permit of the formation of the uterine cavity. The result is a persistence of the embryonic condition—and the uterus is either bicornuate or the median walls of the horns are crushed together to form a septum projecting into the lumen of the uterus (Fig. 61).

In Group I are included :

1. *Uterus Didelphys* (Fig. 65).—This is the extreme variety of double uterus and is very rarely found. There is a wide separation

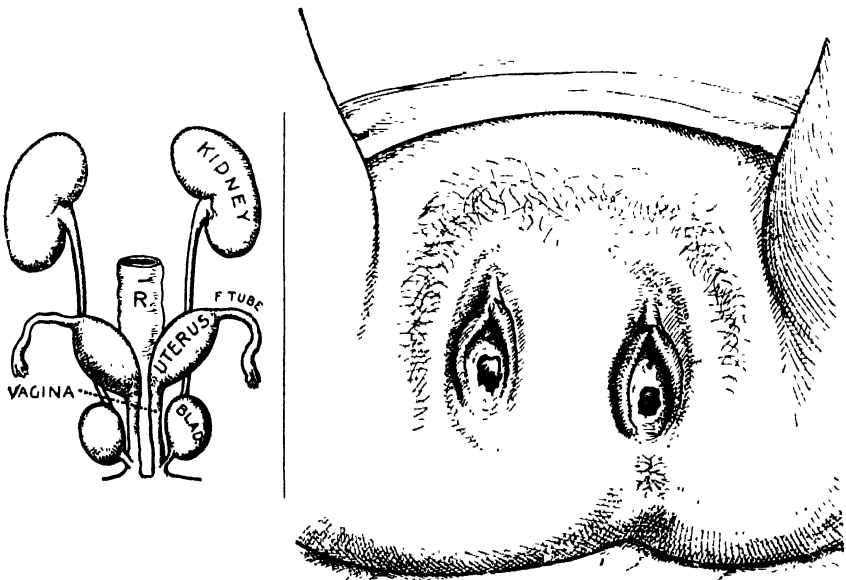


FIG. 65.—Complete Duplication of Genital Tract and Bladder. (Gemmell and Paterson.)

between the two halves. There are two complete uteri, with two vaginal canals separated by a complete septum. There is always a

recto-vesical ligament between the two uteri. This condition is quite compatible with a normal pregnancy and labour, and no symptoms may ever arise. The most interesting case on record is one described by Gemmell and Paterson (Fig. 65).

2. *Uterus Pseudo-didelphys* (Fig. 62).—This type is much more common than the true didelphys. Running between the two halves is a vesico-rectal fold of peritoneum. Except other conditions, such as fibroids, be present such a uterus may carry out all its functions quite smoothly. The complications which may arise if pregnancy occurs in such a uterus are considered later (p. 549).

3. *Uterus Bicornis Bicollis* (Fig. 63).—This variety differs from the *uterus septus* in that there is always a depression at the fundus. There are two ora externa. When the two halves are symmetrical, there may be no symptoms.

In Group II the duplication is confined to the body of the uterus, and is due to disturbances in the development of the epithelial tubes in the later stages of their differentiation.

1. *Uterus Bicornis Unicollis* (Fig. 64).—This is a comparatively frequent abnormality. The cervix is single, but the bodies are separate. There is sometimes a rectovesical ligament passing sagittally between the two horns. Abortion is a common occurrence in this type of deformity. Rupture of the uterus is referred to elsewhere (p. 597).

2. *Uterus Bicornis with Rudimentary Horn* (Fig. 66).—The rudimentary horn as a rule is attached to the single cervix by a band of fibromuscular tissue which is seldom completely canalised. Dysmenorrhœa is a common symptom. There may be a hæmatometra of the rudimentary horn. Pregnancy may occur in such a horn and present symptoms similar to extrauterine pregnancy (p. 359).

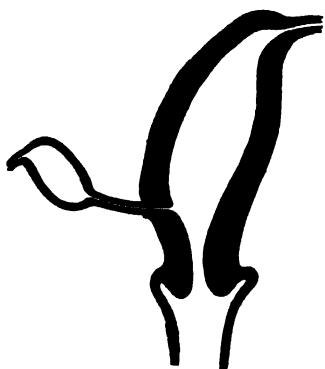


FIG. 66.—Uterus Bicornis (with one horn rudimentary, but seldom with a communicating canal as shown here).

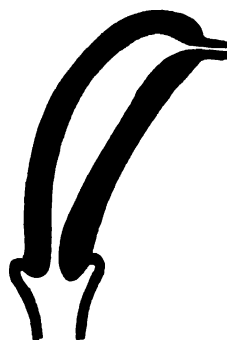


FIG. 67.—Uterus Unicornis.

3. *Uterus Unicornis* (Fig. 67).—This represents an extremely rare condition. Usually this type of deformity will reveal a rudimentary second

horn if careful search is made—the rudimentary horn may be extremely small.

4. *Uterus Septus and Subseptus* (Fig. 68).—Where the septum passes down to the cervix, or passes right through the cervix into

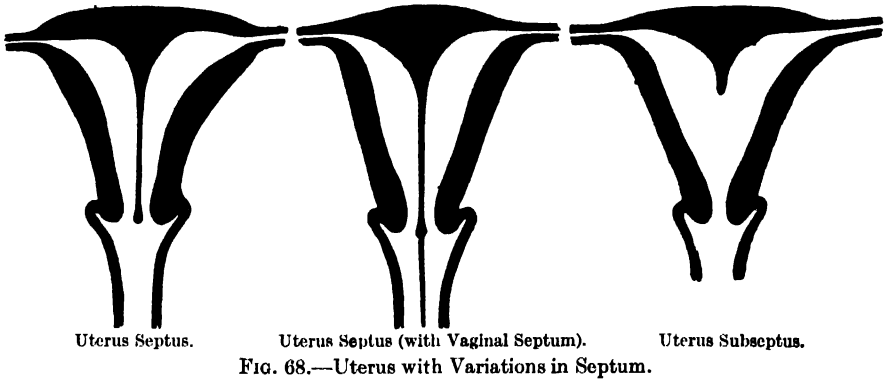


Fig. 68.—Uterus with Variations in Septum.

the vagina, the case belongs to Group I. In the uterus subseptus the septum is incomplete and confined to the body of the uterus: this uterus therefore belongs to Group II. This type of malformation seldom gives rise to any symptoms except where one side does not open freely and an accumulation of menstrual blood takes place. When pregnancy occurs on one side, the other angle of the fundus may resemble a fibroid tumour of the uterus. As may occur in some of these other deformities, there may be persistence of menstrual discharge from one side while pregnancy has taken place on the other. The secretion may be pent up in the non-pregnant half through the developing ovum having occluded the opening.

5. *Uterus Cordiformis* (Fig. 69).—The deformity is very slight. When pregnancy supervenes, the form of the uterus favours the occurrence of a shoulder presentation (p. 476).

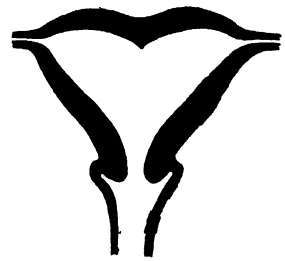


Fig. 69.—Uterus Cordiformis.

6. *Uterus Diverticulatus*.—In this type there are diverticula right into the substance of the uterine wall. It is not certain that the deformity is of developmental origin: it may result from abnormal penetration of the glands into the deeper layers of the muscle. The danger of rupture should a pregnancy develop in a diverticulum is referred to elsewhere (p. 361).

THE CERVIX

There may be congenital absence of the cervix in cases of *uterus defectus*, where there is no communication between the vagina and the mass of tissue which represents the uterus. Duplication of the cervix

occurs, of course, in *uterus didelphys*, while a vertical septum may be found in other types of uterine deformity. Atresia of the cervix is very rare, apart from its occurrence in *uterus defectus*.

The most common deformities encountered are *stenosis of the os externum* and *stenosis of the os internum*. The former is usually associated with an elongated cervix in which there is a "conical cervix" with a "pin-hole" os. This condition is usually found in some of the hypoplastic malformations of the uterus (p. 100). The associated symptoms are those of under-development of the uterus—viz., scanty periods, dysmenorrhœa and sterility (p. 801). Dilatation alone is seldom a successful treatment—even plastic operations to open up the cervical canal permanently are seldom successful.

Stenosis of the os internum may occur with quite a patent *os externum*. The obstruction often seems to be due to a ledge of mucous membrane which covers over part of the cervical canal. Such cases are usually associated with dysmenorrhœa and sterility. Dilatation of the canal with the insertion of a stem pessary may relieve the condition; plastic operations have been suggested but are rarely performed.

THE VAGINA

Absence of the vagina occasionally occurs, even where a uterus is present. Such a uterus is usually rudimentary, but should it be functioning the resulting hæmatometra may become the cause of much discomfort. The special clinical importance of absence of the vagina is the preclusion of sexual intercourse. To deal with the condition several plastic operations have been devised; the most radical is to construct an artificial vagina out of a transplanted loop of bowel. Where the condition requires to be dealt with on account of a painful hæmatometra, the uterus may be removed through the abdomen or an attempt made to establish communication between the uterus and the rudimentary vagina or vagina artificially formed.

STENOSIS OF THE VAGINA.—This may be congenital, especially where the uterus is infantile or defective. Again, such a condition occurs normally among the senile atrophic changes following the menopause. The most common types of organic stenosis of the vagina follow injuries at parturition, or result from the application of strong caustics to the vagina. Such cases must be carefully investigated should pregnancy occur, as Cæsarean section may become necessary. As a rule, however, the tissues soften to a remarkable degree during labour and allow the escape of the child.

LOCALISED ATRESIA OF THE VAGINA.—This condition may occur in the form of a transverse septum. This septum results from a failure

in the canalisation of the distal ends of the Müllerian ducts and forms the "imperforate hymen" (p. 776).

Sometimes a separate fringe of mucous membrane can be identified below the level of the septum, in which cases the septum must represent a failure of canalization at a higher level than the hymen. The septum obstructs the flow of the menstrual fluid, which distends the vagina, giving rise to a hæmatocolpos (p. 776), and may distend the uterus, causing a hæmatometra. Such conditions require incision of the septum, and occasionally, where the hæmatometra is extreme, a hysterectomy.

There is also occasionally encountered a septum at the junction of the middle and upper third of the vagina. This results from faulty

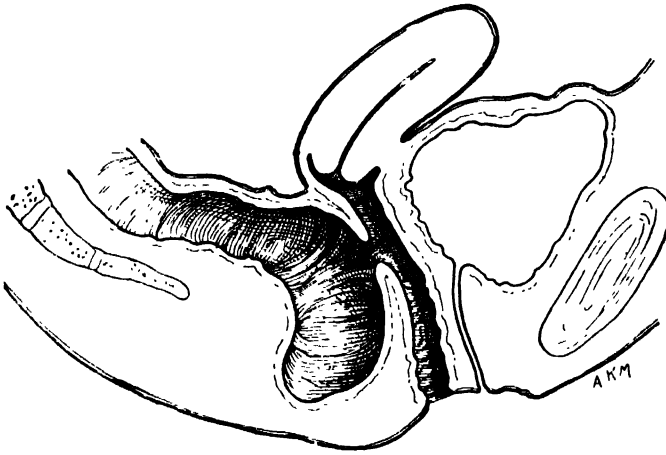


FIG. 70.—Congenital Recto-vaginal Fistula (Vaginal Anus).

canalisation of the vagina (p. 94). The condition is referred to in connection with obstructed labour (p. 540).

The condition (Fig. 70), referred to generally as a "vaginal anus," is extremely rare.

THE VULVA

Apart from the condition of imperforate anus, these deformities are usually associated with the various types of pseudo-hermaphroditism. In the human species there is no true hermaphroditism. In both sexes there are vestigial structures representing the typical organs of the other sex—the epoöphoron in the female represents the epididymis, while the prostatic utricle in the male represents the uterus. In the male type of pseudo-hermaphrodite the gonads are male but the genitalia are female, while in the female pseudo-hermaphrodite the

gonads are female but the genitalia are male. The male pseudo-hermaphrodite is much the more common. In these conditions the

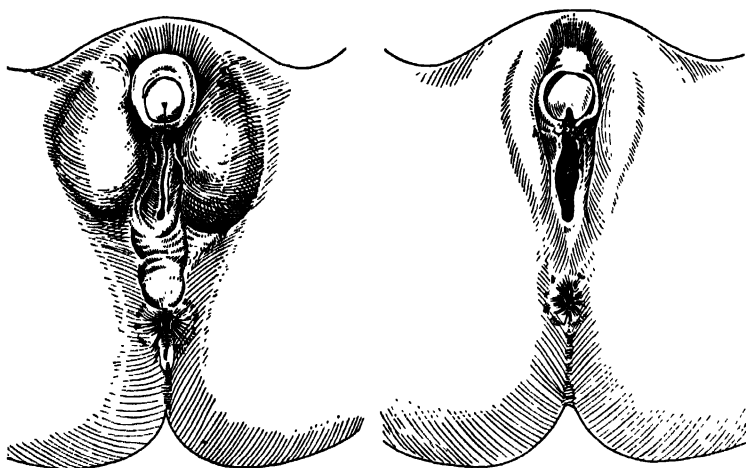


FIG. 71. --Pseudo-hermaphroditism.

external deformity consists in the too great or too little fusion of the various genital folds in the formation of labia majora and labia minora, or scrotum and penis.

CHAPTER V

EXAMINATION OF THE REPRODUCTIVE SYSTEM IN NON-PREGNANT

THE examination of the reproductive organs for the determination of objective phenomena is made for the purpose of establishing a diagnosis, and it is the main foundation on which an opinion should be based. The other two factors concerned in diagnosis—viz., the history (personal and family) and the symptoms or subjective phenomena—are of comparatively secondary importance and must never be trusted to alone in forming an opinion. Before proceeding to the examination, however, the history and symptoms must be inquired into, as not only may the information acquired be valuable, but it gives an opportunity for the doctor and patient to get on friendly terms with one another, and renders the subsequent examination easier from every point of view. An attentive hearing should be given to the account the patient gives of her complaint and her symptoms, and of her own views as regards their nature and origin. Much irrelevant information is frequently vouchsafed, and at other times much cross-questioning is required to get any information at all.

Special points to be elicited are the obstetric history (if any), the date of the last confinement, the number and date of any miscarriages and the relationship of the patient's present symptoms to these events. But in addition she should be questioned regarding her health during previous pregnancies, the nature of her labours and as to whether or not there were any complications in the puerperia.

The menstrual functions must then be inquired into, and any disturbances in connection with them noted. It is important to make sure of the date of the last menstruation if possible.

The cardinal gynæcological symptoms of hæmorrhage, leucorrhœal discharge and pain, must be inquired into in detail, also bladder and rectal disturbances, dyspareunia and sterility, when necessary.

The general condition of the patient must not be overlooked, and information should be elicited as to her nutrition, appetite, digestion, constipation, sleep, nervous system, ability for exertion, etc. *Many patients consult their family doctor or specialist for disturbances which they attribute to disorders of their reproductive organs, but which on careful investigation will be found to be not connected with this system. This should be constantly borne in mind both by specialist and general practitioner.*

The history of previous illnesses and any hereditary tendencies must be noted, and the possibility of syphilitic or gonorrhœal infection must never be forgotten. Very exact inquiry must be made regarding previous diseases or disorders (scarlet fever, tonsilitis, rheumatic fever) which may have affected the kidneys.

PHYSICAL EXAMINATION

1. **Abdominal Examination.**—*Inspection.*—For this purpose the patient should lie upon her back in a good light, with her clothing removed, so that the inspection of the abdomen can be made. Any enlargement is to be noted, with its area of distribution, also skin-markings, condition of umbilicus as regards depression or prominence, and the state of the abdominal wall as regards muscle tone, obesity, etc.

Enlargement may be caused by fat; fæcal accumulation; fluid (a) free; (b) encysted (e.g. distended bladder or kidney, pregnant uterus, ovarian cyst, encysted tuberculous peritonitis); flatulence (e.g. phantom tumour); fibroid of the uterus or other solid tumour.

The mammæ may conveniently be inspected at the same time if pregnancy is suspected.

Palpation of the abdomen in experienced hands is capable of yielding very valuable information. Much experience is needed before the necessary skill is acquired, and the student should lose no opportunity of practising palpation to enable him to acquire the art. Immediately before palpating, the hands should be washed with soap and warm water, and then quickly dried. This secures against chilling the patient (which is apt to cause reflex contraction of the abdominal muscles) and at the same time renders the tactile sense of the examiner more acute. The warmed hands should always be laid flat on the abdomen—gently and lightly at first, so as to accustom the patient to their presence, and to give her time to get over any nervous feeling she may have. Care must be taken to avoid pressing with the points of the fingers as if playing the piano. Ask the patient to breathe easily, and keep her mouth open, so as to relax the abdominal muscles, or if that fails, engage her in conversation which will distract her attention for the time being. With some nervous patients the abdominal muscles contract in spite of everything, and in such cases the administration of an anæsthetic may be necessary.

Palpation is directed towards the feeling of the normal organs in the abdomen, the feeling of abnormal swellings, and the determination of pain, tenderness or undue resistance at some particular point or points. The latter cannot be determined, of course, when anæsthesia has to be employed. In very fat patients palpation is often unsatisfactory.

The bladder should have been emptied and the colon cleared out, if possible, before the examination is undertaken. The possibility

of a distended bladder being mistaken for a cyst must always be remembered, and, if necessary, a long catheter should be passed before the examination is completed. As a rule, the distended bladder is tender on palpation. The cæcum and pelvic colon distended with flatus or scybala are not infrequently mistaken for some pathological condition. Tender spots can often be elicited on pressure, about 2 inches above the middle of Poupart's ligaments, but it is doubtful if such tenderness is really ovarian in origin (see p. 989). It is important to distinguish this from appendix pain. The kidneys should always be palpated, especially the right kidney, to determine the question of mobility and tenderness (pyelitis).

Any abnormal conditions found can be located in one or more of the usually described regions of the abdomen, and their position thus fairly accurately described.

The adipose abdomen is comparatively easily recognised, the fat being partly in the abdominal wall, and partly in the omentum. The difficulty is to be sure whether the fat accounts for the whole enlargement or whether some other condition may be present as well.

Ascites similarly may cause general enlargement of the abdomen, and is recognised by the shifting areas of dullness on changing the position of the patient and by the fluid wave which can usually be elicited. Free fluid in varying amount is a frequent accompaniment of malignant tumours, or of a simple ovarian fibroma, or may result from a burst ovarian cyst.

Flatulence is recognised by its tympanitic note, and "phantom tumour" (p. 177) by the disappearance of rigidity when the patient is anaesthetised.

Abdominal tumours which have their origin in the pelvis most usually produce a more or less *localised* swelling of the abdomen. Exceptions are to be found in large ovarian cysts, large fibromyomata of the uterus and advanced malignant growths which may fill the whole abdomen.

To determine whether a tumour has its origin in the pelvis or not an attempt should be made to dip the fingers into the pelvic brim below the tumour. This will reveal whether or not the tumour is arising out of the pelvis. But when the pedicle is long, the growth may rise up into the abdomen and appear to be quite separated from any recognisable pelvic connection.

Abdominal tumours of pelvic origin may be cystic or solid (or partly both), hard or doughy in consistence, regular or irregular in shape. It is often particularly difficult to distinguish between a cyst with many loculi and viscous contents, and a soft, solid tumour.

In all cases of abdominal swelling the pregnant uterus and the distended bladder must first be excluded.

Cystic abdominal tumours of pelvic origin are almost always of ovarian or broad ligament origin, though occasionally fibrocystic

tumours of the uterus are met with. A fluid wave can usually be detected only in a unilocular cyst, or where there is a large preponderating cyst in a multilocular tumour, the contents of which are fairly fluid in consistence. In hydramnios a fluid wave can usually be elicited.

Fibroids of the uterus are usually hard and often irregular in outline, though sometimes they may be regular in outline and of a soft œdematous consistence. Only on rare occasions can a fluid wave be felt in a cystic uterine fibroid.

The possibility of a hydatid cyst must be kept in mind.

Sometimes the uterus can be palpated through the abdominal wall when it is pushed up by a large intraligamentous cyst or a large cervical fibroid. It may be felt as a sessile solid excrescence on the wall of the tumour.

Percussion gives a dull note over most pelvi-abdominal tumours, unless they are retroperitoneal in origin and consequently push the bowel in front of them. A resonant note is also sometimes found in hæmatocele and encysted peritonitis, from involvement of coils of intestine in the general adhesions.

Auscultation generally gives negative information except in pregnancy. In some few abnormally vascular uterine fibroids and rarely in intraligamentous cysts a souffle may occasionally be detected. Coarse friction may sometimes be heard over ovarian tumours from commencing local peritonitis.

2. Vaginal Examination.—A preliminary vaginal examination may be made with the patient lying on her side with the thighs slightly flexed. The patient should preferably lie on a high couch in a good light. As a rule vaginal examination should be avoided in a *virgo intacta*; and when it is necessary in such a case an anæsthetic should be administered. In such patients rectal examination may give all the necessary information without an anæsthetic. The vulva should be inspected before making a digital examination. Indeed, it is always wise to do so, especially if rubber gloves or finger-stalls are not systematically worn: and if any suspicious indications of syphilis or other active infection are observed the unprotected finger should not be introduced into the vagina.

A complete vaginal examination involves inspection of the parts as well as palpation, and also the use of various instruments to render the examination more thorough. It is now generally made with the patient lying on her back with the thighs flexed and the feet supported on rests. The vulva can be more easily inspected in this position.

Rarely is it necessary to examine the patient while standing, as has been advised, for the purpose of gauging the degree of a prolapse.

Before examining vaginally the hands must be carefully washed in warm water, and dried, and the first and second fingers, preferably encased in a glove or finger-stalls, as has been stated, should be

anointed with some simple sterile lubricant. In the case of an unmarried woman the first finger only should be used.

The points to be noted on *inspection* of the vulva are : first, the outer aspect of the labia majora, and then their inner aspect after they have been gently separated by the fingers. The underlying parts are severally inspected, special attention being paid to the urethral orifice and the vestibular fossa. The urethra should be gently pressed from above downwards to determine the presence of urethral discharge, and the openings of Bartholin's ducts should be inspected and the glands themselves palpated to see if they are enlarged. Any abnormal vaginal discharge can at the same time be recognised. Prolapse of the vaginal walls or cervix can best be recognised by separating the examining fingers, palmar surface downwards, so as to open the vaginal orifice as widely as possible, and then asking the patient to "press down" or to cough.

The internal examination is then proceeded with, and the index and, if possible, the middle finger as well of the right hand are introduced into the vagina. Though the right hand is usually employed, it is a good thing to cultivate ambidexterity in vaginal examination.

The condition of the vaginal walls is noted, the roominess or contraction of the canal, the amount of secretion and the presence of new growths or abnormalities. The condition of the outlet should be noted, especially as regards sensitiveness, lacerations or undue relaxation, protrusions and thickening or tenderness of the urethra.

The vaginal portion of the cervix and the external os uteri are then felt for. The external os lies normally at about the level of the ischial spines, and about the centre of the pelvic cavity. It is normally directed backwards. Note whether the os is that of a nullipara or of a parous woman (Fig. 14), and whether it has been greatly lacerated in delivery. A cervix in a nulliparous woman which has been treated by dilatation or other surgical procedure may resemble that of a multipara. The presence of Nabothian follicles (p. 908), of hypertrophy, of patulous os, of protruding polypi, or of malignant disease, may be detected.

Before proceeding to the all-important bimanual examination, the fingers should explore the vaginal fornices, especially the posterior fornix, and note any protrusion or tenderness there. The presence of scybalous masses in the rectum can be recognised by the fact that they can be "pitted" on pressure through the posterior vaginal wall.

3. Bimanual Examination.—The patient now draws up her legs so that the soles of her feet lie flat on the couch, and at the same time she slightly abducts her thighs. In many clinics and in some private consulting rooms a special couch with leg rests is used. The authors are in agreement that this is unnecessary. It is, of course, important to have the abdominal wall relaxed, and the patient should be encouraged to keep her muscles slack just as in abdominal palpation.

The two fingers of the right hand in the vagina are kept fixed, while the surgeon's left hand is placed flat on the abdomen above the symphysis pubis.

The first object is to recognise and palpate the uterus between the two hands, and two manœuvres are necessary for this purpose. First, the fingers in the vagina should push up the uterus towards the abdomen, and secondly, the left or external hand should press down over the

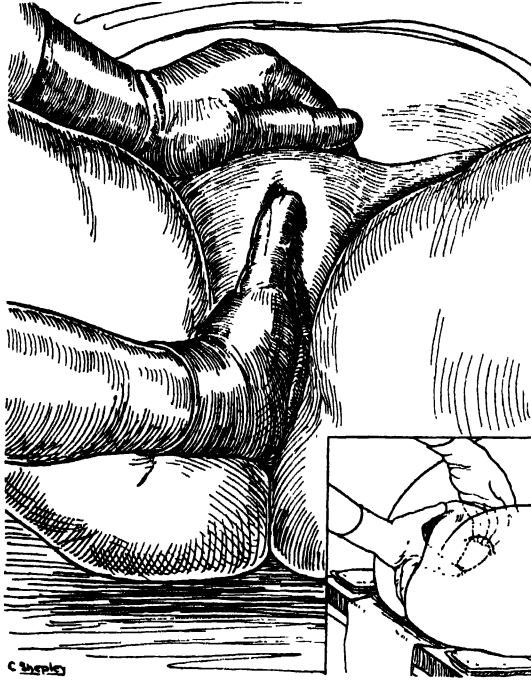


FIG. 72.—Bimanual Examination. Patient in Dorsal Position.

The fingers of the right (internal) hand are disposed as follows:—(a) Two fingers in vagina (fore and middle fingers) or forefinger alone if the canal is narrow (virgin) with third and little fingers flexed on palm; (b) two fingers in vagina and third and little fingers passed up behind perineum as in inset.

brim of the pelvis, and, as soon as the fundus of the uterus is recognised, the hand should be quickly and gently slipped down behind it and the uterus grasped between the fingers in the vagina and the external hand. The errors the inexperienced examiner is apt to make are either to put the fingers of the external hand in front of the uterus just above the symphysis, or to get on one or other side of the uterus and thus miss the fundus. It is seldom even in patients with adipose abdominal walls that one is unable to feel the uterus bimanually.

When the uterus is retroverted, it can often be replaced bimanually, or, at any rate (even if partially fixed), pushed up to the pelvic brim

and examined bimanually. The size of the uterus can be fairly accurately estimated in this way by the experienced gynaecologist, and it is very seldom necessary to use a sound for measurement. A careful estimation is made also of the position, shape, consistence, mobility and sensitiveness of the uterus when thus grasped between the hands, and its relationship to surrounding structures (a point of the highest importance in the diagnosis of tumours) can be established. On occasion the introduction of a sound into the uterine cavity enables the bimanual examination to be more conclusive in obscure cases.

After the uterus has been identified, the fornices must be explored bimanually. Normal ovaries can usually be felt in patients with lax abdominal walls. In cases where they cannot be distinguished readily they may fairly safely be regarded as not being abnormal to any great extent. A good guide to the position of the ovaries is the inner edge of the psoas muscles. If the thighs are widely abducted, the psoas muscles are rendered tense, and their inner edge can be recognised by the abdominal hand. The ovaries should lie at their inner edge. The Fallopian tubes can seldom be felt unless they are pathologically enlarged or thickened.

Normally the pouch of Douglas is empty, though sometimes a coil of small intestine may be felt gurgling under the finger. There should be no feeling of resistance, nor should the patient evince pain while pressure is made through the posterior fornix. Sometimes the utero-sacral ligaments can be felt, but they can usually be better felt *per rectum*.

In the *posterior fornix* a large number of abnormal conditions may be found, which have naturally gravitated into the pouch of Douglas. Care should be taken not to mistake faecal accumulation in the colon for a new growth, as may easily be done. The chief abnormalities which may be felt in the posterior fornix are: the body of the uterus in backward displacement; a prolapsed ovary or ovaries; an ovarian tumour (cystic or solid); fibroids of the uterus; enlarged tubes and ovaries and intraperitoneal effusions of blood, serum or pus. Diverticulitis and growths of the rectum may sometimes be felt through the posterior fornix.

In the *anterior fornix*, the body of the uterus should normally be felt. The empty bladder cannot be recognised, but when distended it is felt as a fluctuating sac which tends to push the uterus backwards. Comparatively few swellings are encountered in the palpation of the *anterior fornix*, but occasionally a fibroid in the middle of the anterior wall of the uterus is felt, or an ovarian tumour (most commonly a dermoid cyst). Tubal swellings such as a pregnant tube or a hydro- or pyosalpinx are very rarely found in this situation.

In the *lateral fornices* many pathological conditions may be found; neoplasms and inflammatory enlargements of the ovary, broad-ligament cysts, subperitoneal fibroids, inflamed tubes, ectopic pregnancy and

cellulitis. A distended cæcum or loop of pelvic colon may simulate a neoplasm and necessitate another examination after the administration of an aperient.

Healthy ureters cannot be palpated, but thickened or inflamed ureters may sometimes be palpated through the lateral fornices by pressure against the upper posterior pelvic wall; such pressure elicits pain. A stone in the lower part of the ureter may also be occasionally felt through the lateral fornix.

It may be necessary to examine a patient in the *genupectoral position* in certain cases where a retroverted uterus has to be replaced and, on account of its large size or impaction, cannot readily be pushed upwards out of the pelvis.

A *rectal examination* is useful when a pelvic examination is indicated in a *virgo intacta*. The patient may lie either on her back or left side, and the index finger, protected by a rubber finger-stall and well anointed, should be gently introduced into the anus. Unless the lower bowel is empty a rectal examination gives little reliable information.

The pouch of Douglas can be more thoroughly explored through the rectum than through the vagina, as the finger can be passed higher up *per rectum*. The utero-sacral ligaments are easily accessible by this route, and can be felt readily.

A *bimanual* or *recto-abdominal examination* can be made, and a *recto-vagino-abdominal examination* with the index finger in the vagina and the middle finger in the rectum may be *useful*.

In any of the foregoing examinations the administration of an anæsthetic may be desirable in order to get complete relaxation of the abdominal muscles. Such relaxation makes the palpation of the pelvic organs much more easy and the findings more reliable. Examination under anæsthesia should always be practised in obscure cases. The main drawback is that one can obtain no guidance from the pain or tenderness experienced by the patient—these features should be noted at the preliminary examination.

4. Instrumental Examination.—In the routine examination of the female pelvic organs instrumental assistance is seldom necessary, as the educated touch of the experienced gynæcologist gives him eyes, so to speak, in his finger-tips. He can thus usually satisfy himself by the methods of examination above described, except in the case of the bladder, in the examination of which the cystoscope provides valuable and essential information.

For the visual inspection of the vagina and cervix, as well as for the local application of medicaments and for operative purposes, a speculum is necessary. Three types of speculum may be described: (1) Sims' Speculum; (2) Fergusson's Speculum; and (3) the Bivalve Speculum.

Sims' Speculum is of historical interest as having been designed by Marion Sims in his pioneer work on vesico-vaginal fistulæ. It must

be remembered that it was designed for use with the patient in "Sims' position," *i.e.* the *semi-prone* position (Fig. 447). The patient is placed lying well over on her left side, the left arm hanging down over, or resting on, the near side of the couch, and with the knees drawn up, the right slightly higher than the left so that its inner surface rests upon the couch. In this position the pelvis is raised and the weight of abdominal viscera is thrown to the front, with the result that a negative pressure is produced in the vagina. When the vaginal walls are separated by the introduction of the speculum, air enters and balloons out the whole passage, enabling its walls and the cervix to be

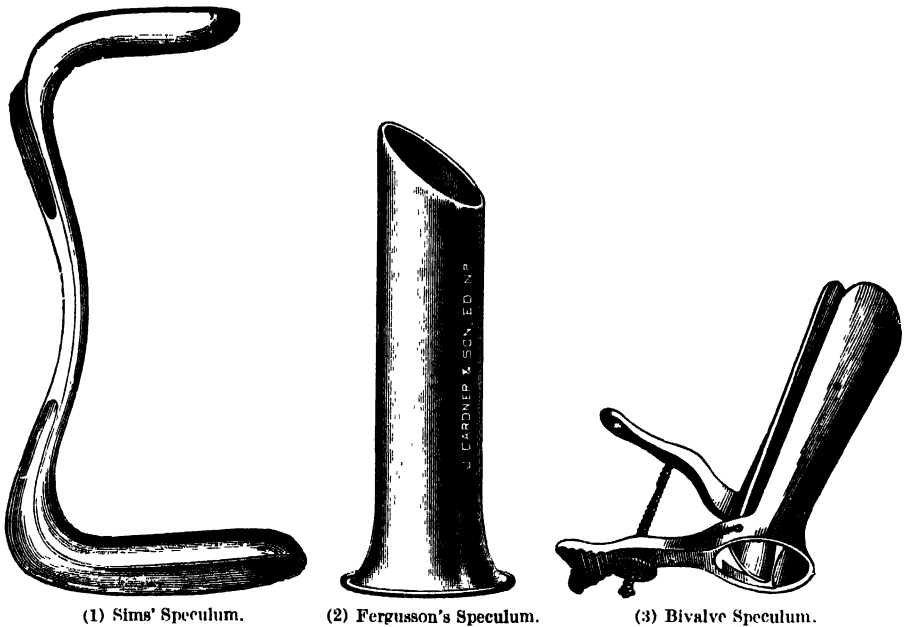


FIG. 73.—Three Varieties of Speculum.

inspected. The same effect is obtained in any other position (*e.g. genupectoral*) in which the pelvis is raised. Essentially Sims' speculum is merely a retractor for the perineum and posterior vaginal wall. It is made in two sizes, for nulliparous and parous women respectively, joined by a connecting bar which is used as a handle. When used with the patient in the dorsal position the cervix and upper vagina cannot be seen unless the cervix is drawn down by a volsella. Auvard's speculum, used commonly in vaginal operations, is just a modification of Sims' instrument with a weight on the handle to make it self-retaining.

Fergusson's Speculum is now seldom employed. It is a circular tube of plated metal cut obliquely at the upper end so that one side is longer than the other. After lubrication it is insinuated into the vagina by a rotatory movement, so that the longer side corresponds

to the posterior vaginal wall. With a little adjustment the cervix fits into the upper end and can then be inspected by reflected light. The main limitation to its use is that the cervix cannot be drawn down, and it is therefore inconvenient for any applications to the cervix or for any operative procedures.

The *Bivalve speculum* is perhaps the most useful for ordinary diagnostic work, but care must be taken to see that it has sufficiently long blades and that these are not so broad as to cause discomfort on introduction. Many of the instruments on the market suffer from both those faults. After lubrication of its outer surfaces the speculum is introduced as far as possible and the blades separated. If the cervix is not at once visible a little adjustment of the instrument brings it into view. As the speculum is withdrawn, allowing the blades to close partially as it comes out, the vaginal walls can be inspected. It has the same inconvenience as Fergusson's speculum so far as any operative procedure is concerned.

The *uterine sound* (Fig. 74) is now seldom employed for diagnostic

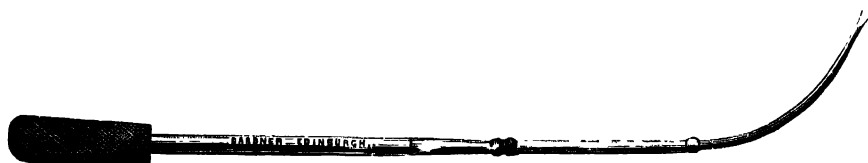


FIG. 74.—Uterine Sound.

purposes. Its routine use is greatly to be deprecated, and it should only be passed into the uterus when the patient has been surgically prepared for examination or for operation under anæsthesia. The more expert the gynæcologist becomes in the bimanual examination the less does he resort to the use of the sound.

The sound is a pliable metal probe for introduction into the uterine cavity, with a knob $2\frac{1}{2}$ inches from the point (to indicate the normal length of the uterine cavity) and with notches at intervals of 1 inch, so that the depth to which it enters the enlarged uterus can be seen at a glance. The handle of the sound is roughened on one side to correspond to the concavity. The instrument must, of course, be boiled before use, and the position of the uterus determined if possible by a careful bimanual examination before its introduction. If on bimanual examination the size and feeling of the uterus and/or the clinical history suggest early pregnancy the sound must on no account be used.

The chief diagnostic uses of the sound are to ascertain: (1) the length of the uterine cavity; (2) the direction of the uterus; (3) the angle between the cervix and the body of the uterus; (4) irregularities, roughness or dilatation of the cavity of the uterus; (5) the relation of the uterus to a pelvic tumour in a difficult bimanual examination.

The passage of the sound is usually painless, and normally there

should be no hæmorrhage. The chief danger in the use of the sound is infection of the uterine cavity. It is manifest that its introduction into the uterus through an unprepared vagina may carry organisms into the uterine cavity, and where the cervix is infected—*e.g.* with the gonococcus—the danger is obvious. The sound must therefore be passed only after careful cleansing of the lower passages and the exposure of the cervix by a vaginal speculum, so that, under direct vision, it is inserted into the external os. In certain abnormal conditions the uterus is very soft and there is a risk of the sound perforating its wall, even when no great pressure is used. *This possibility must always be kept in view.*

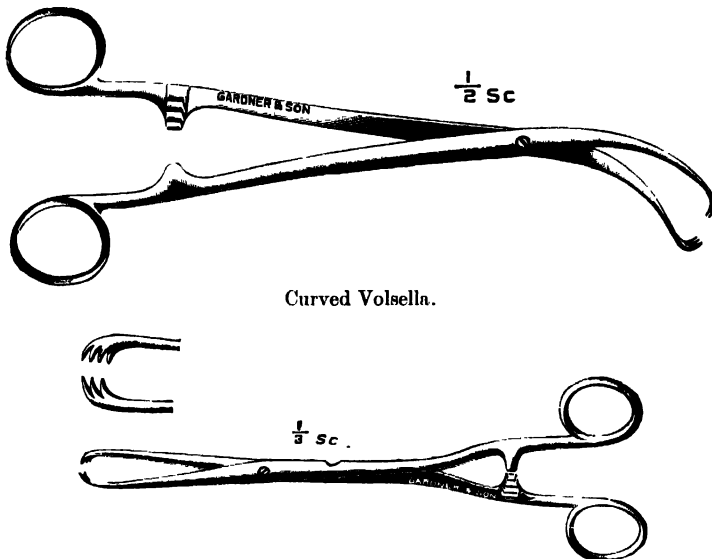


FIG. 75.—Curved and Straight Volsellæ—more frequently termed Volsellum Forceps.

(Some gynaecologists prefer the single-pronged instrument.)

Volsella.—The volsella (Fig. 75) is a form of sharp-toothed forceps for grasping the cervix through a speculum and steadying it while passing the sound, or for drawing down the cervix towards the vulva to admit of its being inspected more readily. This can be done quite easily in most healthy women without giving rise to much pain. When the uterus is fixed by inflammatory or malignant infiltration of the broad ligaments, or enlarged by tumour growth, mobility is impaired more or less. Conversely, in cases of prolapse, the mobility of the uterus is increased.

SPECIAL EXAMINATIONS

A Wassermann test of the blood should be made in every case in which there is the slightest suspicion of syphilis. In many hospitals it is a routine practice in all in-patients.

The microscopic examination of vaginal discharges gives much useful information, and in all cases of suspected gonorrhœa smears should be made from the discharge from the cervix and urethra. Where infection by the *trichomonas vaginalis* or by the monilia or thrush fungus is suspected, a drop of the vaginal discharge should be mixed on a slide with two or three drops of saline and examined as a hanging-drop preparation, or dried and subsequently stained.

A catheter specimen of the urine drawn into a sterile flask should be sent to the bacteriologist in all cases of urinary infection. A large (non-catheter) specimen, preferably of morning urine, is required for the Aschheim-Zondek and other pregnancy tests (p. 167), while for hormonal estimations in some cases of amenorrhœa, etc., due to endocrine deficiency or for pregnandiol estimations, a twenty-four hours collection is requisite.

In some cases of functional menstrual disturbance it is of diagnostic value to obtain a small portion of endometrium for microscopic examination. Special small curettes are used by which this may be done without forcible dilatation of the cervix and without anæsthesia.

In cases of suspected cancer it may be necessary to excise a small portion of the cervix for microscopical examination. Similarly the scrapings obtained by a diagnostic curettage of the uterus must be examined histologically. Such pieces of tissue should be placed at once in 10 per cent. formalin solution to fix them.

In cases of sterility it may be necessary to estimate the patency of the Fallopian tubes by insufflation (p. 809), or examine by X-rays after injection of lipiodol into the uterus and tubes (p. 813).

Examination of the pregnant reproductive organs will be found described in Chapter VIII, under "Signs and Symptoms of Pregnancy."

PART II
NORMAL PREGNANCY

CHAPTER VI

ANATOMICAL CHANGES THE RESULT OF PREGNANCY

PREGNANCY is a process which affects not only the uterus and the other parts of the genital canal; but it is associated with widespread changes throughout the body—it is probable that no organ or tissue is left unaffected. With increasing knowledge conviction is growing that the changes are caused chiefly by hormonal activity.

BONY PELVIS

Since early times it was believed that during pregnancy there occurs a progressive softening and lengthening of the ligaments of the pelvic joints. In the Hippocratic period it was taught that at the first labour this change allowed of an expansion of the pelvis which thereafter remained permanently enlarged. Pelvic radiography has demonstrated that there is a widening of the gap between the two pubic bones during pregnancy and an increased vertical mobility, sometimes appreciable by palpation. There is also a slight widening of the sacro-iliac joints.

Roberts¹ (Liverpool) has provided the following figures in regard to the changes in the pubic and sacro-iliac joints :—

	Number of Patients.	Average Mean Width of Symphysis Pubis.	Combined Width of Sacro-iliac Joints.	Number of Patients.
Non-pregnant—				
Nulliparae . . .	59	2.6 mm.	3.6 mm.	64
Parae	71	2.6 „	3.9 „	76
Pregnant—				
Primigravidae . .	77	4.2 „	4.5 „	43
Multiparae . . .	75	5.0 „	4.5 „	61

The cause of the alteration in the pelvic joints during pregnancy is not clearly understood. There would seem, however, to be good reason for the belief that it is one manifestation of the widespread endocrinal activity found at that time and that oestrone and, possibly, progesterone are concerned. Some writers have described the existence of a special hormone—*relaxin*—but on this question further evidence is necessary before a definite pronouncement can be made.

¹ Roberts, *Proc. Roy. Soc. Med.*, 1934, vol. xxvii. (Obstetrical Section, pp. 51-59).

The effects of these changes must necessarily be to produce a certain increase in the pelvic girdle during labour, and it is possible that this may be of importance in minor degrees of pelvic disproportion. It is known that in many cases these changes may assume clinical importance. For example, the softening and increased mobilisation of the sacro-iliac joints when excessive is an important cause of the low backache commonly felt by pregnant and puerperal women, and pain over the pubes and even marked disability may follow excessive displacement at this joint.

A most important result of the relaxation in the pelvic joints is the increased mobility between the ossa innominata and the sacrum, and between the coccyx and sacrum.

In the case of the ossa innominata and sacrum the movement is a "nutatory" (Matthews Duncan) one round a transverse axis passing through, or at the level of, the second sacral vertebra. Depression downwards and forwards of the ossa innominata (as in the Walcher or "hanging leg" position, p. 531) results in a dipping downwards of the pubes and an increase in the conjugate diameter of the brim. A raising of the ossa innominata upwards and backwards (as in the lithotomy position) results in a decrease in the conjugate diameter of the brim but an increase in the conjugate diameter of the outlet. The former position, however, increases the obliquity of the plane of the brim, while the latter diminishes it—and obliquity of brim may influence engagement of the presenting part, as we shall see later. This raises the question of the *ideal posture in labour*—a detail in the management of labour to which sufficient attention is seldom given.

The greater mobility of the coccyx allows of a marked increase in the conjugate diameter of the outlet, and as the child is expelled the coccyx may be pushed back as much as 1 inch (2.5 cm.).

UTERUS

The uterus enlarges progressively during pregnancy, being transformed from a small, pear-shaped organ 3 inches (7.6 cm.) long and weighing about 1 ounce (30 grams) into a large ovoid and thin-walled sac about 12 inches (30 cm.) long and weighing about 2 lbs. (1000 grams). The increase in substance of the organ is due to a great proliferation and hypertrophy of all the tissues of the uterine wall. This increase affects the serous, muscular and mucous coats and the blood-vessels, nerves and lymphatics. The changes in the *mucous membrane* have already been described (Chapter IV).

The *muscular wall* increases in bulk due to an enlargement of the original fibres and to a new formation of muscle tissue. The individual muscle fibres become greatly increased in size, their bulk at the end of pregnancy being five to ten times greater than that obtaining in the non-pregnant uterus (Fig. 76).

The *blood-vessels* throughout the uterus become increasingly enlarged and their walls thicken, and the tortuous arrangement which is characteristic of the non-pregnant uterus is even more exaggerated during pregnancy. The whole uterus becomes turgid with the increased circulation that pours through it. The vascularity is more evident in the placental area and the placental site is often recognisable in this way on the peritoneal surface of the uterus.

The hypertrophy of the uterus is most pronounced in the body. The *cervix* becomes increased in size to a slight extent, but the main anatomical change in the neck of the womb consists of a gradually increasing softening. Cervical glands secrete actively and the canal becomes plugged with tenacious mucus (*operculum*) which is a very important protection against infection. In Fig. 77 there is shown a section through the cervix at the eighth month of pregnancy, which shows the extraordinary degree of secretory activity exhibited by the cervical glands.

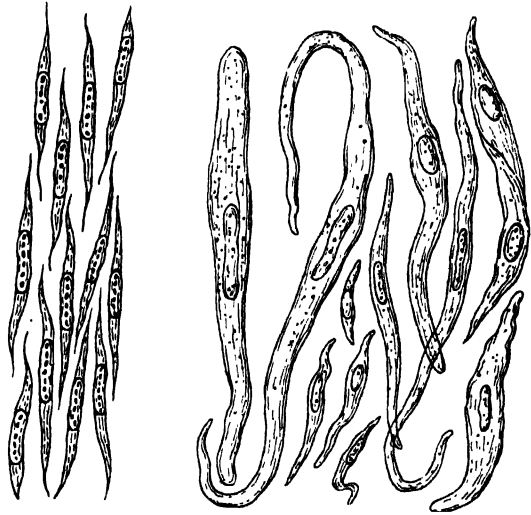


FIG. 76.—Muscle Fibres from Non-Pregnant and Pregnant Uterus. (Sappey.)

During the first months of gestation the corporeal wall increases in thickness; thereafter it becomes thinned out, and at the end of pregnancy it is only about $\frac{1}{2}$ inch (6 mm.) thick. By virtue of this thinning the uterus becomes converted into a soft, compressible bag, and, especially in the end months of pregnancy, the foetal parts can often be made out with great distinctness by palpation and the foetal movements may easily be seen on the abdominal surface as the child's limbs impinge against the uterine wall.

The *shape* of the uterus exhibits marked changes during pregnancy. The body becomes more and more globular during the first four months and the softening of the structures renders it more mobile than during the non-pregnant state. After the fourth month the shape becomes oval and the increase in length is greater than the increase in width.

The *position* of the body changes. During the first three months its growth is within the pelvis and in this stage the increased size and mobility tend to make it fall forwards against the bladder in a

position of increased anteflexion. By the tenth to the twelfth week the fundus ascends over the pelvic brim and the uterus comes into contact with the anterior abdominal wall, the angle which it makes with the cervix becoming gradually opened out. Thereafter the organ rises, progressing higher in the abdomen until at the end of pregnancy it may touch the liver. As the uterus rises upwards it pushes the intestines to the sides and the back of the abdomen, so that the anterior wall remains



FIG. 77.—Longitudinal Section through Cervix at Eighth Month of Pregnancy. Compare with Fig. 16 (p. 21).

throughout pregnancy pressed up against the front wall of the abdomen. The posterior wall rests on the vertebral-column only up to the third and fourth lumbar vertebra, the space behind it being occupied by the intestines. The increased mobility which is characteristic of the early months becomes gradually lost as the womb fills the abdomen, though throughout pregnancy, especially in a multipara with lax abdominal walls, there may still remain a degree of mobility.

Throughout pregnancy the uterus is *usually rotated on its long axis to the right*, so that its anterior surface faces slightly to that side. This deviation is merely an exaggeration of the position of the non-pregnant organ, which usually exhibits a similar twist. It is

believed, also, that the presence of the rectum plays some part in determining the direction of the torsion. Very occasionally the rotation may be to the left side.

The *areas or subdivisions of the uterus* become very much altered during pregnancy. The change in the *cervix* has been noted as a softening with but little increase in length. The increase in the body is specially marked in the section below the insertion of the round ligaments during the earlier months, but more pronounced in the section above these structures—viz., the *fundus*—in the later months. The *isthmus* area does not increase much vertically until the later weeks and more especially during labour (p. 368). The striking feature in this area is a very early and pronounced softening—hence Hegar's sign of pregnancy (p. 165). In consequence of this pronounced softening in the isthmus there results great mobility of the body on the more anchored cervix. Very easily, therefore, on occasions, may the elastic enlarged body be mistaken for a tumour of ovary or uterus.

OVARIES

The *ovaries* show increased vascularity, this change being especially prominent in the ovary containing the corpus luteum of pregnancy. This ovary is larger than the other, and the corpus luteum can usually be recognised where it bulges on its surface even up to the late weeks of pregnancy. The surface of the ovary during pregnancy frequently exhibits scattered areas of a soft, fleshy material which is bright red in colour and which may at first sight suggest an inflammatory process. If a small portion of this material be removed and submitted to microscopic study it is found to consist of decidual tissue.

The nature of the functional activities of the ovary during pregnancy is not yet fully understood. It is known that ovulation ceases and this, as also the suspension of menstruation during pregnancy, has been ascribed to the inhibitory influence of the corpus luteum. It is known, however, that, in the human, pregnancy can continue normally despite removal of the corpus luteum, unless this is carried out during the early months, and there is reason for the belief that the activities of the corpus luteum are after an early stage transferred to the placenta (p. 57). Within the total range of the combined "luteal" activities of the corpus luteum and placenta there are included: (a) the preparation and maintenance of the changes in the uterus for the reception and development of the ovum; (b) the prevention of ovulation; and (c) the control of uterine tone. These subjects are discussed more fully in Chapter III.

Whilst ovulation is in abeyance during pregnancy it is by no means true to say that all follicular activity is arrested. Many follicles grow and reach a considerable degree of maturation, after which they undergo atresia. The theca lutein cells formed during maturation persist after

the disappearance of the ova and granulosa elements and constitute the "interstitial gland" which presents such a characteristic picture of the ovary of pregnancy. At first organised round the atretic follicles these cells become later separated off as isolated packets of cells scattered throughout the ovarian tissue. Their function has been already discussed, more especially in the prepubertal period (p. 60).

FALLOPIAN TUBES

The *tubes* exhibit increased vascularity during pregnancy, and their muscular walls may become hypertrophied to a small extent. In some instances the stroma-cells of the mucosa lining show a decidual change. As pregnancy advances the tubes are drawn farther and farther upwards in the abdomen and lie along the sides of the uterus with their long axes almost vertical.

VAGINA

The vagina shares in the increased vascularity which affects the other parts of the genital canal. This is attended by a characteristic *port-wine coloration* of the vaginal walls and the structures round the vaginal orifice. The walls, in addition, become softened and their distensibility increased. The vaginal secretion is increased in quantity and the cavity is occupied by a thick, dull-white substance of a creamy consistence which often escapes as a leucorrhœal discharge. It has a distinctly acid reaction due to the presence of lactic acid, and under normal conditions it is free from pathogenic organisms. The secretion consists almost entirely of masses of epithelial plaques which have desquamated from the stratified lining membrane of the vagina. The appearances are those characteristically found in the smear obtained from the vagina of an œstrous animal, and it is probable that they represent a change induced in the vagina by the large amount of œstrone which circulates in the blood-stream during pregnancy (p. 57). The fluid in the secretion is derived partly from the cervical glands and partly from a transudation from the vagina walls. In it there are numerous epithelial cells and long, non-motile bacilli—Döderlein's *vagina bacillus* (p. 642). Possibly Döderlein overstated the importance of the *vaginal bacillus*. There is little doubt, however, that when the pH content is high (4.5 to 5) the bacillus is present in abundance. The lactic acid is produced by the action of the bacilli on the glucose secreted by the vaginal epithelial cells which in turn have converted the glycogen stored there into glucose. The vaginal flora is more fully discussed in Chapter XLV. p. 866.

The muscular walls of the vagina exhibit considerable hypertrophy during pregnancy.

BREASTS

From the early weeks the woman often complains of a sensation of fullness and pricking in the mammæ. These symptoms are often present before there is any visible swelling of the breasts, and are frequently so definite that a woman may be aware of commencing pregnancy by her experience of similar sensations in former pregnancies.

From the second month visible enlargement of the breasts occurs, due partly to the hypertrophy of the secreting elements, which become palpable as firm knot-like structures, and partly to the increased vascularity. An indication of this latter change is seen in the distension

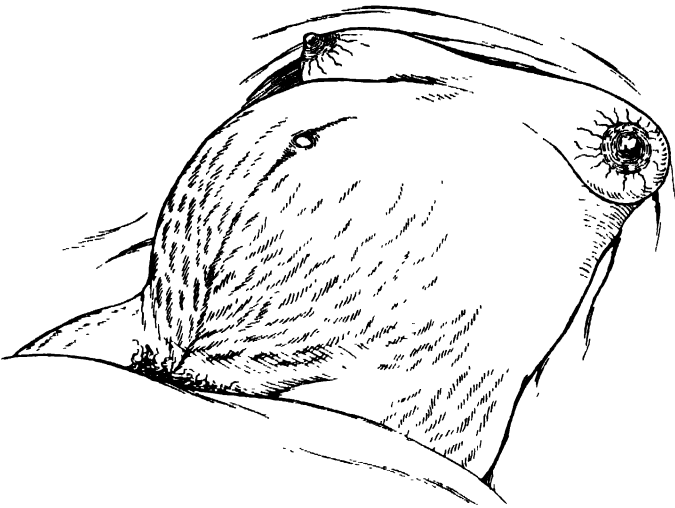


FIG. 78.—Breasts and Abdomen of Pregnant Woman, showing the *Striae Gravidarum*, the *Linea Nigra*, and the pigmentation of the areola.

of the surface veins, which become visible as they cross the breast in the subcutaneous tissues. The nipples at the same time show characteristic changes. They become larger and more deeply pigmented (Fig. 78). After the fourth month a thin secretion can be expressed from the nipple if the breast is massaged firmly towards the centre (colostrum). The skin area surrounding the nipple—the *primary areola*—becomes more and more pigmented and enlarges to form round it an annular zone of less deeply pigmented skin—the *secondary areola*. The degree of pigmentation of the areolæ varies in different women: in some it is marked, in others it is hardly evident. Its intensity varies roughly with the natural pigmentation present in the other skin areas. It is in general terms deeper in brunettes and less deep in blondes, though there are many exceptions. In the primary areola the pale rounded elevations formed by the sebaceous glands become more prominent

during pregnancy owing to the hypertrophy of these glands—the *Montgomery tubercles*.

The secretory functions of the mammary glands are now recognised to be under endocrinal control. There is evidence in lower animals that the œstrogenic hormone of the ovary is capable of stimulating the ducts and tubules to increased growth, although secretion of milk cannot be obtained by this means alone. It is possible that progesterone plays some part. Recent investigations have shown that the actual secretion of milk is determined by a lactagogic hormone (prolactin) of the anterior pituitary lobe. It is believed that this is kept under check during pregnancy by œstrone and that the elimination of this from the maternal system after birth permits of the activation of the breast by the special anterior pituitary hormone (p. 64). Whilst the development of the glands and the initiation of milk secretion appear to be under purely hormonal control, it seems probable that the maintenance of lactation is influenced by a nervous mechanism in which the hypophysis is involved (Nelson).¹

URINARY BLADDER AND URETHRA

The bladder becomes raised in the latter half of pregnancy. Indeed it becomes an abdominal organ. This leads to marked elongation of the urethral canal. The changes which the ureter and the kidney pelvis exhibit during pregnancy are described in Chapter XII.

ABDOMEN

The enlarging uterus, as we have seen, displaces the intestines upwards and to the sides as it rises to occupy the abdomen, so that its front surface lies against the anterior abdominal wall. The structures of the abdominal wall become stretched during pregnancy. In some instances, especially in multiparous women, a wide separation of the bellies of the recti muscles may occur with the formation of a gap in the midline, through which a hernia of bowel may occur subsequent to labour.

The skin of the abdominal wall usually exhibits traces of the stretching process in the form of *striae gravidarum* (Fig. 78). These consist of streaks in the skin of varying width on the front and sides of the lower abdominal wall. They are due to dehiscence of the superficial layers of the skin with a consequent exposure of the more vascular underlying cutis. The fresh striae are thus pink or purplish in colour. Old-standing striae are white or silvery. Not infrequently striae spread from the abdominal wall on to the flanks and thighs. Pigmentary changes on the abdominal wall are common. The most

¹ Nelson, *Physiological Reviews*, 1936, vol. xvi., No. 3, p. 488.

characteristic consists of the *linea nigra* (Fig. 78) extending in the midline from pubes to umbilicus and sometimes above this. These changes have probably an origin similar to the pigmentary deposits round the nipples and occasionally in other regions, for example, on the forehead and the face (the *chloasma uterinum*). In some women they are formed to an extreme and even to a disfiguring degree. They are attributed to overactivity of the suprarenals induced by pregnancy.

The *changes in the ductless glands* during pregnancy are considered in Chapters III and VII.

CHAPTER VII

PHYSIOLOGY OF PREGNANCY

INTRODUCTION

DURING pregnancy the maternal organism is required to accommodate the fertilised ovum, supply it with nourishment, and dispose of its excretory products. The growth of the uterus must be provided for; the control of implantation established; the maternal tissues protected against the destructive powers of the trophoblastic villi; the blood-stream adjusted to provide a slowly moving placental circulation; the digestive and absorptive systems empowered to acquire nourishment which they must pass on to the fœtus; the excretory organs enabled to cope not only with the waste products from the increased maternal activity, but also directly with the waste products of the fœtus itself; the mammary glands prepared for the function of lactation; and, finally, sufficient energy must be acquired to enable the mother to expel the fully developed child from the uterus.

In the study of the physiology of pregnancy we must accept the principle that the fertilised ovum is a separate organism, growing within the territory of the mother's body, but acting in its own interests, and taking over from the mother those substances which are necessary for its growth and maintenance. Let us consider here the biological relationship of the fertilised ovum to the mother. There are three possibilities. The ovum may be a parasite of the same type as a benign neoplasm, drawing stores from the mother without payment. The second view is that the ovum acts as a malignant tumour, not only living at the expense of the mother, but also destroying her tissues to do so. A third possibility is that, while the ovum derives its supplies from the mother, its presence may have a beneficial influence on the vital processes of the mother. While many support the first view, there are few students of the problem of pregnancy who are prepared to subscribe to the second view. However, both those views represent pregnancy as a sacrifice of the mother in the interests of the species. It is of great scientific and sociological interest to find that accurate evidence has been collected in support of the third view. As a result of his observations on animals and on women, Paul Bar, the distinguished French obstetrician, came to the conclusion that, where there is a healthy fœtus in a healthy mother, pregnancy represents a condition of "*symbiose harmonique homogène*." He has shown that the mother

takes her food better, that she utilises more completely the food which she does take, and that at the end of pregnancy she has increased her tissues beyond the amount required to provide for the increase in size of the uterus and mammary glands. His laboratory results have been confirmed by others, and there is ample clinical support for his view from the fact that many women of impaired health and vitality enjoy greatly improved health throughout pregnancy. While this view is most acceptable, we shall see that in many cases pregnancy causes grave disturbances in the metabolic processes of women, particularly at certain stages in its progress.

THE RATE OF GROWTH OF THE FERTILISED OVUM

The developing ovum is made up of the foetus, the amniotic fluid, the foetal portion of the placenta, and the membranes. The composition of these structures has been ascertained by exact analysis, and the results obtained for the foetus throw a very interesting light on the stages of development. The actual substance requirements of the foetus are not large: a normal infant at birth, weighing 3200 grams, contains a little less than 100 grams of nitrogen, the whole of which could be supplied from the mother's diet in about ten days. The following table, however, shows that up to the end of the seventh lunar month not more than one-fourth of prenatal requirement, in terms of protein and salts, has been secured :—

COMPOSITION OF THE FŒTUS (Michel)

Age (Weeks).	N Grams.	P Grams.	Ca Grams.	Mg Grams.
16 . . .	2·941	0·662	0·419	0·021
20 . . .	6·054	1·448	2·214	0·077
24 . . .	11·048	2·444	4·082	0·133
28 . . .	16·005	3·527	5·881	0·190
40 . . .	72·700	18·673	33·260	0·815

These figures indicate that during the early months of pregnancy, when the greatest clinical disturbances take place, the quantitative demands of the foetus are in fact very small. The disturbances are due to imperfect adjustment of the relationship of mother and ovum which occurs in the earlier months.

THE METHODS OF FŒTAL NUTRITION

In the earliest days of its life the ovum obtains nourishment from several sources, from the follicle cells which cling to the ovum when it is set free, from the secretion of the Fallopian tube (which is analogous

to the white of a hen's egg), and from the secretion of the uterine glands. These sources are of a temporary nature.

PREPLACENTAL STAGE.—When the ovum commences to undergo cell division the earliest group of cells to be separated off is the trophoblast. This layer surrounds the ovum completely, and its most important function is that of regulating the food supply of the ovum. Its cells are endowed with the power of digesting maternal tissues, and it is in virtue of this property that the trophoblast plays such an important part in the imbedding of the ovum in the uterine wall. The ovum digests a passage for itself into the endometrium through the action of the trophoblast (p. 76).

Within the first month the trophoblast increases its physiologically active surface by sending out branching processes, the trophoblastic villi, into the cores of which passes mesodermal tissue containing blood-vessels. By the second month the actual presence of a *tryptic ferment* can be demonstrated in those villi, though such a ferment is probably present at an earlier stage. This ferment digests the maternal tissue, including the walls of the blood-vessels, and the ovum comes to lie in a medium of liquefying endometrium and blood. At this stage the glycogen, which is stored in such abundance in the premenstrual endometrium (p. 48), is probably an important source of nutrition. This liquid medium is easily available for absorption, transportation, and distribution inside the ovum by the foetal blood-stream which passes to and from the tips of the villi. The complete villus, with its epiblastic covering and mesoblastic core, is now described as a chorionic villus.

PLACENTAL STAGE.—The burrowing activity of the chorionic villi is restricted by the growth of the decidua, and a balance is eventually established between the penetration of the villi and the resistance of the maternal tissues by the completion of the development of the placenta. As soon as the villi become organised into those multiple fine branching processes covered with the two layers of epiblastic tissue, the epithelial Langhans' layer and the plasmodial or syncytial layer, with the foetal vessels inside the core, they lose their power of invading the maternal tissues and destroying the vessel walls. The tryptic ferment cannot be identified after the fourth month. Their future development is directed towards increasing the absorptive surfaces by additional numbers of branching processes. It is as such organs of absorption that these chorionic villi appear in the mature placenta, bathed by the maternal blood-stream. The special development of the individual processes which form the anchoring villi, attaching the ovum to the uterine wall, has been dealt with in the description of the imbedding of the ovum (p. 80).

With the development of the mature placenta, we have the maternal blood separated from the foetal blood by the two-layered epiblastic covering of the villus, some connective tissue, and the foetal vessel walls—an arrangement practically identical with that of the wall of

an intestinal villus, which is *the* pattern of an absorptive organ. As the pregnancy proceeds, changes take place in the villi. The cells of Langhans' layer begin to degenerate by the end of the fourth month, and in the later months the villi are covered by a thin layer of syncytium, beneath which can be identified a very thin layer of canalised fibrin, probably the remains of the necrosed Langhans' layer. Inside the villus, the vessels enlarge and the embryonic connective tissue becomes less conspicuous, so that in the later months the two blood-streams are separated by a thin layer of syncytium, a film of mesoderm and the endothelium of the foetal vessels. Towards the end of pregnancy, fatty changes can be identified in the connective tissue of the villi, probably of a degenerative type, and the vessel walls show signs of an endarteritis obliterans.

THE STAGES IN NUTRITION.—We may therefore divide foetal nutrition into two stages: (a) the preplacental and (b) the placental. In the former the ovum derives its nourishment from the destroyed tissues of the mother, whereas in the latter the two blood-streams come into more and more intimate relationship, though they never mix. For many years discussion has taken place as to whether the placenta, as an agent in nutrition, acts, as Harvey expressed it, by "a sort of digestion," or in a purely mechanical manner. In the preplacental stage the nutrition of the foetus appears to be secured by the secretory and selective action of the tissues of the ovum, but in the later stages the process has become more and more mechanical. The chorionic epithelium acquires the function of a semi-permeable membrane, allowing a greater amount of material to pass to the foetus each day, but there is still some selective activity as is shown by the different concentrations in the maternal and foetal blood-streams of such easily diffusible substances as glucose and amino-acids.

Several years ago an attempt was made to establish a theory of foetal nutrition by the complete transfer of leucocytes containing nutritive material from the maternal circulation, through the placenta, to the foetal circulation. This view was shown to be untenable, when it was found that in cases of leucocythæmia, occurring in pregnancy, the blood picture in the foetus was quite normal, showing no evidence of the transfer of leucocytes from the maternal circulation.

THE CONTROL OF THE IMBEDDING OF THE OVUM

The imbedding of the ovum (p. 75) must be controlled from two sides: (1) the ovum must be able to establish itself securely in the uterine endometrium; (2) the destructive action of the early ovum on the maternal tissues must be checked in the interests of the mother.

With regard to the first, experiments on animals seem to indicate that the attachment and growth of the ovum in the uterine wall is due to the action of the corpus luteum, since the removal of the latter

causes abortion of the ovum. That the parallel in human beings is not exact has been shown by clinical observations on women in the early months of pregnancy, who have had an active corpus luteum removed in the course of an abdominal operation without prejudice to the ovum. Even in animals this protective influence of the corpus luteum may not be necessary after the ovum secures a firm placental attachment to the uterine wall. The early stages of imbedding are almost certainly associated with some form of ovarian activity, as the early endometrial response to pregnancy is almost identical with the premenstrual appearance of the same tissue, which latter condition, we have seen, is controlled by the activity of the ovary (p. 48).

The destructive action of the trophoblastic villi is most extensive and, if unrestricted, might carry the ovum right into the muscular coat of the uterus. This action is controlled by the formation of the decidua. In the histological study of the early ovum it will be seen that the extension of the villi is greater along the course of the blood-vessels than through the stroma and gland tissue, where the decidual cells form a barrier. The completion of this defensive action against the foetus is shown by the development of the highly organised placenta. An extensive study of this subject of maternal placentation led Sir William Turner to describe it as a maternal reaction to protect herself against the invader, or, in modern phrase, to restrict the action of its enzymes.

In the pathological conditions of hydatidiform mole (p. 300) we have an example of chorionic activity running riot, uncontrolled by the decidual tissue.

THE FUNCTIONS OF THE PLACENTA

The formation of the placenta has been described in Chapter IV. Its activity in foetal nutrition and its protective action in the interests of the mother have already been referred to in the present chapter. We may now consider in what other ways the placenta may act as a barrier between the maternal and foetal organisms. Is the foetus protected against the action of potent drugs which may be administered to the mother, or against diseases from which the mother may suffer?

PERMEABILITY TO DRUGS.—Over a hundred years ago it was known that potassium cyanide passed through the placenta to the foetus. Chloroform and ether pass to the foetal circulation quite freely. In the therapy of syphilitic infections it is very important to know that the salts of arsenic and mercury reach the foetal tissues. In the conduct of labour the administration of powerful analgesic and hypnotic drugs like morphine, hyoscine and atropine must be carried out with caution owing to the action of these drugs on the foetus. The salts of lead, iodide and bromide of potassium, quinine and

salicylates administered to the mother, all appear in the foetal circulation.

THE PASSAGE OF ORGANISMS AND TOXINS.—The placenta seems to act as a protection to the foetus against certain organisms which may have invaded the maternal tissues. The malarial parasite never passes from the mother to the foetus. In syphilitic infections the *Spirochaeta pallida* is able to make its way into the tissues of the foetus, but this penetration depends on the vitality of the organism at the various stages of placental development. In the case of a patient with an old untreated syphilitic lesion, or in one who has acquired syphilis at conception or within the early months of pregnancy, the spirochæte is able to enter the foetal tissues much more easily than in a case where the infection does not occur until the second half of pregnancy, by which time the placenta is fully developed. In the last type of case, the child may be born without any sign of syphilis, and may never show any trace of congenital syphilis. In gonorrhœal patients the organism does not cross the placenta—the gonococcal lesions which may appear in the child soon after birth are due to infection acquired while the child passes down the parturient canal.

In tuberculous infections, while typical lesions may be found in the decidual or maternal portion of the placenta, the foetal portion of the placenta very seldom shows such lesions. Cases have been described in which the *tubercle bacillus* has been found in the blood of the umbilical vein (p. 279). In enteric fever the organisms seem to pass to the foetus fairly easily. In pneumonia and in general pyogenic infections the organisms very rarely reach the foetal tissues. In the case of smallpox, there are historic examples of distinguished men born with smallpox lesions already present, and recent epidemics have shown examples of the direct transmission of smallpox *in utero*.

The toxin or toxins associated with eclampsia is often transmitted to the foetus, which after birth may have convulsions. In such cases the urine of the newborn infant usually contains albumin.

The transmission of toxins and antitoxins is equally important. There are no records to show that any of these substances can be kept back by the placenta. This organ, however, seems to exercise a selective action, because examination of the foetal blood in some cases has shown a higher amount of antibody than the maternal blood.

The placenta contains large quantities of œstrone and a gonadotropic hormone closely resembling that secreted by the anterior lobe of the pituitary gland. The fact that the secretion of œstrone and œstradiol continues when the ovaries have been removed during pregnancy, indicates that these hormones can be secreted by the placenta (p. 57). The source of the gonadotropic hormone cannot yet be determined. While there are certain differences between the gonadotropic hormones extracted from the anterior lobe and from the placenta, the proof of independent placental secretion fails because the removal

of the anterior lobe of the pituitary gland during pregnancy is almost always followed by abortion or resorption of the fœtus.

Experiments on animals have shown that the placenta is permeable to drugs in the opposite direction—strychnine and hydrocyanic acid injected into the fœtus pass quickly into the maternal circulation.

THE FUNCTION AND SOURCE OF THE AMNIOTIC FLUID

This bland alkaline (pH 7 to 7·6, the same as the blood) fluid was formerly considered to play an important part in the nutrition of the fœtus. There is no doubt that a considerable amount may be swallowed by the fœtus during the course of pregnancy, as may be proved by the amount of lanugo, hairs and epidermal cells found in the foetal stomach and intestine. The small albuminoid content, 0·19 per cent., makes it very unlikely that this fluid plays any important part in the nourishment of the fœtus. Secondly, this fluid may contain the urine voided by the fœtus; but we know that the amniotic cavity and fluid are present before the foetal kidneys are completely developed, and before the urogenital sinus is opened (p. 97). Again, the amniotic fluid is present, even in increased amount, where the development of the fœtus has been arrested, as in hydatidiform or carneous moles. However, it is certain that in the later months of pregnancy the fœtus does pass some urine into the amniotic sac. In cases of congenital atresia of the urethra, we find the retention of urine causing hydronephrosis (although congenital hydronephrosis may occur without atresia of the urethra). The small amount of urea present in the amniotic fluid, from 0·02 to 0·04 per cent., indicates that foetal urine can form only a small part of the whole. That it should form a considerable part is unlikely in view of the fact that so much of the fluid may be swallowed by the fœtus.

The most important functions of the amniotic fluid are mechanical. It forms a water-jacket, protecting the fœtus not only against sudden changes of temperature, but also against the effects of violent movements by, or accidental violence to, the mother. The fluid also prevents the formation of adhesions between the fœtus and the walls of the cavity in which it lies, as may occur in the condition of oligo-hydramnios (p. 308).

SOURCE OF THE FLUID.—From neither laboratory nor clinical observations can we discover the precise origin of the amniotic fluid. While in birds it is certainly of foetal origin, in human beings it is probably derived from several sources.

We have seen above that the amniotic fluid contains a certain amount of foetal urine, as indicated by the presence of urea, which appears in the amniotic fluid as early as the fourth week of intrauterine life and increases steadily in amount, though in very small amount,

until the end of pregnancy. That this source plays a relatively small part in the production of the whole fluid may be adduced not only from the clinical considerations mentioned above, but also from the results of the experimental injection of phloridzin into pregnant animals. Phloridzin produces a transient glycosuria by its action on the renal epithelium. The foetal tissues are found to be impregnated with phloridzin, but no glucose can be found in the amniotic fluid, as would be the case if the foetal kidneys were very active.

That the fluid is more likely to be of foetal than of maternal origin might be inferred from the fact that in the herbivora the amniotic fluid contains l  vulose which is present in the foetal, but not in the maternal blood. There are certain facts, however, which indicate a close relationship between the fluid and the maternal circulation. Certain substances, like potassium iodide and sodium indigo sulphate, pass almost straight into the amniotic fluid, while the foetal kidneys show no trace of it. In cases of maternal diabetes the amniotic fluid contains glucose, and in dropsical conditions of the mother the amniotic fluid is frequently present in excess.

The relationship of the amniotic fluid to the maternal blood-stream is not that of a simple transudation—the lower freezing-point of the amniotic fluid indicates that it cannot be derived from the maternal blood-serum by simple filtration. The selective nature of the relationship is shown by the fact that certain antibodies of the maternal serum do not appear in the amniotic fluid.

The selective or secretory mechanism most probably rests in the amniotic epithelium. The amnion itself possesses no blood-vessels apart from those which lie directly under it, where it covers the placenta and umbilical cord. Its connective tissue, however, has a good lymphatic circulation, as is shown by the number of lymphatic channels seen in microscopic sections. In hydramnios, where there is an excess of amniotic fluid, the epithelial cells show under the microscope all the signs of increased activity; vacuoles appear within the cells, move towards the surface and discharge into the amniotic cavity. By the method of "vital staining," Goldmann found that, when certain stains are injected into the mother, they are well distributed throughout the maternal tissues, but do not pass over to the foetal tissues. When he used pyrrhol blue, he found the granules of the stain in the cells of the amniotic epithelium and the amniotic fluid coloured blue, whereas neither the stain nor the colouring could be identified in the tissues or the fluids of the foetus apart from those tissues which were in contact with the amniotic fluid, namely, the epidermis and the lining of the alimentary canal.

In connection with the activity of the amniotic epithelium, it should be remembered that this epithelium covers the whole length of the umbilical cord, allowing an intimate relationship between the vessels of the cord and the fluid secreted.

We may conclude, therefore, that while the greater part of the amniotic fluid is obtained through the secretory activity of the amniotic epithelium, it is not certain whether this epithelium acts on substances derived from the maternal or the foetal blood-streams. While under normal conditions the foetal circulation plays a part, it is certain that when the foetus dies the fluid can still be produced through the maternal circulation. The foetal urine forms only a small part of the whole.

THE CIRCULATORY SYSTEM

THE HEART.—Many experienced clinicians declare that the heart enlarges during pregnancy, and that the enlargement is due to hypertrophy of the left ventricle. It is undoubted that the heart has more work to do during pregnancy, in keeping the increased volume of blood flowing through the enlarged uterus and the placenta. The hearts of a large number of pregnant women have been weighed, and an average increase of about 9 per cent. noted. This increase is not much greater than might be expected from the increased bulk of the whole maternal organism.

Sir James MacKenzie, on the other hand, maintained that there is no true enlargement of the heart throughout pregnancy. The increased size of the uterus, particularly in the later months of pregnancy, broadens the base of the chest and tends to flatten the diaphragm. It also pushes the whole heart more against the anterior chest wall. The result of this movement is to carry the apex of the heart outwards and upwards, so that it lies in the fourth interspace. The most obvious effect of this is to increase the breadth of the cardiac dullness. At the end of labour the heart swings back to its normal position. The electrocardiograph has been employed in investigating the changes in the heart during pregnancy, and there has been found little evidence to support a true functional hypertrophy.

The actual cardiac output has been measured in the dog, and it has been found that during the latter part of pregnancy the minute volume is one-third to one-half greater than in the non-pregnant animal. It is impossible at present to determine whether the increased work required from the heart during pregnancy is accomplished by actual hypertrophy, or by drawing entirely upon the reserve force of the heart.

THE VASCULAR SYSTEM.—There are commonly many alterations on the venous side of the circulation. Varicosity of the veins of the legs, thighs and vulva may be very marked. These varicosities may appear so early in pregnancy as to make it unlikely that the actual bulk of the uterus is an important factor in their production. There may be changes in the vessel walls, of either toxic or vasomotor origin—the increased volume of blood may be a factor at a later stage. It is only when the head becomes fixed in the pelvis towards the end of

pregnancy, that direct pressure is likely to be exerted on the large pelvic vessels.

Other portions of the peripheral circulation are altered in character. In the breasts, the mammary artery, usually imperceptible, becomes dilated; the veins become distended and are very obvious on the surface of the breasts. Probably the arteries generally become dilated to a slight extent.

Many women show marked pulsation in the jugular veins—formerly regarded as a sign of back pressure. These pulsations have, as a rule, little or no pathological significance; they indicate that the blood is returning freely from the periphery and lying in the jugular veins which form part of the reservoir to the right auricle. When the peripheral circulation becomes filled up with blood, as it does during the muscular activity of labour, there is no surplus blood in the jugular veins, and the pulsations disappear.

THE BLOOD-PRESSURE.—The blood-pressure is very little raised during pregnancy—the highest systolic value in a normal pregnancy rarely reaches 120 mm. Hg. There is, however, a considerable increase in the pulse-pressure, especially in the later months. With the onset of labour in a normal case, the systolic pressure may rise to 140 mm. Hg; but when this figure is reached during pregnancy, a definite toxæmia should be suspected. It has been shown that such a rise in blood-pressure may be identified some time before the appearance of a toxic albuminuria (p. 211).

THE BLOOD.—Various changes have been described in the maternal blood during pregnancy. The blood volume is increased by about 400 c.c.—to provide for the placental circulation and for the general maternal hyperæmia. This increase in volume is associated with a definite hydræmia—an increase in the blood moisture and a lowered specific gravity—up to the seventh month. In the later months the blood density is increased: the red cell count and the hæmoglobin regain normal figures, while there is a great increase in the leucocyte content. With the onset of labour this leucocytosis increases very rapidly from about 15,000 to figures over 25,000, especially high in primigravidæ and in cases of prolonged labour. The leucocytosis disappears quite quickly during the puerperium, except in cases of sepsis. Barcroft records that during the second half of pregnancy in dogs, the spleen becomes very much reduced in size, but regains its normal dimensions soon after delivery. This phenomenon he correlates with the increase in blood volume, and thinks that it is likely to occur in women.

While the blood volume and the total blood-plasma are increased during pregnancy, up to about 25 per cent. above the non-pregnant level, there are variations in the plasma proteins. With the original hydræmia there can be identified by the third month a fall in plasma proteins which continues until the fifth month. From the sixth month there is a steady concentration, chiefly in the fibrin fraction, up to

the time of labour—the serum albumin remains under the normal figure while the globulin fraction increases slightly. At term the blood proteins are still 7 per cent. below the non-pregnant level. There is a very great total increase in the fibrogen content during pregnancy, so that in the last three months it may be 30 per cent. above its normal range. This increase in the fibrin and fibrinogen appears an excellent provision for diminishing blood loss during labour and for the physiological thrombosis which occurs in the uterine wall at that time; the blood platelets increase up to the time of labour, reaching a density of about 1,500,000 per cubic mm., and naturally their agglutinative properties increase with their concentration. In the later months the blood sedimentation rate is greatly increased, probably in association with the high fibrinogen content, but returns to normal by the fourth week after delivery.

The alkalinity of the blood is slightly reduced in the later months of pregnancy, as shown by the lowered carbon dioxide combining power of the blood. This is related to the diminished alveolar carbon dioxide tension, and explains the tendency to acidosis (p. 160) towards the end of pregnancy, and especially during labour. The blood chlorides are slightly reduced.

Among other noteworthy changes in the blood there is a definite increase in the antitryptic ferment content—probably an important provision against sepsis. There is also an increase in the cholesterol content, and from the seventh month there may be described a true lipæmia. This lipæmia may be associated with increased bactericidal power in the blood, may be a provision for the needs of the fœtus in fat, or even more simply a preparation for lactation.

In the later months of pregnancy the calcium content of the blood is slightly reduced—a fact which may play an important part in the increased irritability of muscle and nerve tissue, particularly in the uterus itself. This diminution in the calcium content may also be associated with a tendency to raised blood-pressure and œdema.

There is also found in the serum a ferment which has the power of digesting chorionic villi. During pregnancy the ends of the chorionic villi which lie in the placental blood sinuses frequently become detached and may be carried away by the maternal blood-stream. Such transported villi have been identified in the tissues of the liver, the heart, and the voluntary muscles, and might give rise to extensive lesions were it not for the digestive power of this serum ferment. Abderhalden made use of this property in elaborating his serological test for pregnancy. The basis of his test is that a woman, whose blood-serum can digest placental tissue, is pregnant (p. 167).

During pregnancy the amount of œstrone in the blood rises steadily to a maximum which is reached just before term (p. 57). The blood also contains in very high concentration the gonadotropic hormone of the anterior lobe of the pituitary gland (p. 63).

THE RESPIRATORY SYSTEM

Pregnancy causes changes in the respiratory passages—portions of the nasal mucosa become reddened and thickened. The larynx has its mucous membrane thickened, with redness and oedema ; this change may cause marked impairment in the voice of singers. Decidua-like cells may be identified in the very hyperæmic sub-mucosa of the false vocal cords and of the interarytenoid fold.

The upward movement of the uterus, broadening the base of the chest, inhibits the movements of the base of the lungs. As a result, when a pregnant woman lies in bed, there is a tendency to stasis at the bases of the lungs. Crepitations may be heard in this site, but they disappear after a few deep breaths. This shortening of the chest is compensated by an increase in breadth, and it has been shown that the lung capacity is actually increased. While there is no great increase in the consumption of oxygen or the excretion of carbon dioxide, there is a great increase in the amount of air inspired.

The gaseous interchange during pregnancy will be considered under metabolism (p. 145).

THE DIGESTIVE SYSTEM

During the early months of pregnancy many women suffer from minor digestive disturbances, of which the most typical is *morning sickness*. We shall consider the ætiology of morning sickness later (p. 199), but it is well to state here that it is most probably due to a minor toxic disturbance.

After the period of morning sickness there are many women who find that their general health is much improved by pregnancy. Their appetite is improved, their digestion more satisfactory. Actual analysis has shown that, during pregnancy, the undigested food residue is reduced in amount—women get more out of the food which they ingest.

On the other hand, many women suffer considerably from *dyspepsia* and flatulence. At the end of pregnancy these may be attributed to pressure on the stomach and intestines by the uterus. However, such symptoms may occur fairly early in pregnancy and are probably another indication of a mild toxic disturbance.

Many women, in fact most women, suffer from *constipation* or increased constipation. There are several factors involved in this tendency. The inhibition during pregnancy of the pressor influence of the posterior lobe of the pituitary gland (p. 64) causes a loss of tone of the musculature of the bowel. There is also a loss of tone in the muscles of the abdominal wall, due to overstretching, and further, especially in the later months, there is the pressure of the enlarged uterus. Deficiency of the anti-neuritic B vitamin in the diet is another possible factor (p. 146).

The tendency to *hæmorrhoids* which is found in so many pregnant women should be regarded chiefly as a circulatory disturbance, due to the same causes as the varicose veins in the legs, thighs and vulva referred to previously. The growing uterus presses on the rectal and the other pelvic veins. While *hæmorrhoids* may cause great discomfort during the later months of pregnancy, they usually disappear after delivery.

The *liver* is the seat of marked changes during pregnancy. The whole organ is enlarged and hyperæmic: in the later months it is forced upwards and backwards by the uterus, requiring a correction to be made for liver dullness at this stage. Fat appears in the cells occupying the central portions of the lobules. The glycogen content is reduced; the biliary channels and the central veins, with their tributaries, are dilated. The cholesterin content of the bile is increased, a possible factor in the frequency of gall-stones among parous women. The destruction of red blood corpuscles in the interests of the foetus leads to an increased concentration of bile pigments.

THE PREPARATION OF THE FOOD CONSTITUENTS FOR TRANSFER TO THE FŒTUS

Careful studies of the problems of pregnancy have indicated that the foetus is usually built up by the deviation of a certain proportion of the products of digestion of the food, rather than by a conversion of the mother's formed tissues. The latter method is followed during the pre-placental stage of development and in cases where the food supply of the mother is inadequate. Even where the food supply is the immediate source of foetal nutrition, however, the food must first be digested and absorbed, and then enter the maternal circulation in the form in which the products of digestion usually circulate before their utilisation or conversion by the tissues and organs of the body.

These substances reach the placental circulation, where they are transferred from the maternal to the foetal circulation. The method of transfer cannot be specified accurately in each case, but inferences can be made from the identification of certain intermediate substances at various stages in the process. The active mechanism is probably the epithelium covering the chorionic villi. A great variety of ferments has been described as occurring in the tissue of the placenta—ferments capable of effecting digestion of each of the proximate food principles. All these ferments have been isolated from the autolysed placenta; but, as the composition of placental tissue alters so quickly when it is removed from the uterus, it is very difficult to standardise the presence of these various ferments. As we shall see, such a complete digestion as might be indicated by the ferments described, hydrolytic, oxidative and deamidising, need not occur.

CARBOHYDRATES.—Truly diffusible substances like glucose, and

similarly urea, pass through the placental barrier very easily. The concentration of glucose in the maternal blood is slightly higher than in the foetal blood, thereby ensuring a constant osmotic flow. The sugar in the foetal blood at the moment of birth is higher when the percentage in the maternal blood has been raised, either by prolonged labour or by the use of anæsthetics in delivery. Glycogen must be broken up into glucose before it can be transferred to the foetus; the surplus sugar which arrives at the placental circulation is stored up on the maternal side of the placenta, and in the syncytium and trophoblastic islands of the foetal side, as glycogen, and transferred to the foetus as required in the form of glucose. The foetus cannot store glycogen in its own tissues until the last quarter of gestation, when the storing is carried out by the activity of its own tissues.

FATS.—The transfer of fat to the foetus is a very interesting problem. No true fat cleavage has been proved to take place in the placenta. The feeding of mothers with fat has been shown experimentally to cause no appreciable increase of fat in the foetus; when pregnant animals are fed with stained fat, the stained fat does not reach the foetus. Fat does occur in the walls of the chorionic villi—presenting a picture very like the absorption of fat by an intestinal villus. However, we cannot prove that this fat was not formed by the foetal tissues themselves; the fat which is found in the villi in the later months of pregnancy, and which gives the villi the appearance of degenerating tissue, is almost certainly the result of tissue changes in the foetus. The one form of fat which has been reported to pass the placental barrier unchanged is cholesterol. All that can be said with certainty is that fat does not readily pass through the villi, if it passes at all; and that it is never present in the same concentration in the foetal blood as in the maternal blood. The fat of the foetal body, which does not appear until late in pregnancy, is formed by metabolic processes in the foetus itself, and is probably built up from glucose. The fat or lipid content of the maternal blood is always greater than that of the foetal blood, but this may be a preparation for lactation rather than for the nutrition of the foetus.

PROTEINS.—The presence of a very active proteolytic enzyme in the early months of pregnancy has already been described (p. 132). However, this enzyme has not been found after the fourth month, by which time the burrowing power of the villi has been lost. Throughout the placental stage of nutrition, it seems probable that proteins are not reduced below the stage of albumoses, and that resynthesis occurs as soon as the foetal tissues are reached.

Amino-acids are present in large amount in the placental circulation: these proteins can pass the placental barrier quite easily. The foetal blood usually contains a larger percentage than the maternal blood. While these substances represent an advanced stage in the cleavage of the proteins, it is not necessary to assume that proteins must be

broken down to this point before becoming available for use by the foetus. They more probably represent some of the end products of tissue change in the foetus, which are being excreted into the maternal circulation.

IRON.—A supply of iron is absolutely essential for the formation of respiratory pigment in the foetus. Again, as the iron content of milk is so very small, the foetus must acquire a supply of iron not only to produce the respiratory pigment before birth, but also to form the reserve supply to cover all the iron requirements of the child throughout the period when it is fed solely on milk. Comparative physiology shows that the liver of the young rabbit at birth contains much more iron than that of an adult rabbit, and this is probably true of the human foetus also. The chief supply of iron is the hæmoglobin of the maternal blood, and the disintegration of red blood corpuscles by the trophoblastic and, later, the chorionic villi can be observed quite easily. Placental extract produces hæmolysis very quickly; the eosin reaction of hæmoglobin can be identified at the free border of the syncytium, and loose organic compounds of iron can be demonstrated in the deeper layers of the villi. In ruminants the actual transference of red blood corpuscles through the epithelium of the villi may be observed, but, in women, disintegration of the corpuscle is the initial stage.

CALCIUM AND PHOSPHORUS.—The calcium for the foetus reaches the foetal circulation without difficulty. The foetal blood is actually richer in calcium than the maternal. One very interesting fact about the supply of calcium for the foetus is that, where the food of the mother does not contain an adequate amount of calcium for the foetus, the calcium salts are removed from the maternal skeleton. The robbing of the bones and teeth may go on until the mother's bones are almost calcium-free—mere fibrous tubes and membranes. This exaggerated decalcification is of the same type as occurs pathologically in acute osteomalacia (p. 517). For bone formation phosphorus is as important as calcium, and while the total phosphorus content of the maternal blood is greater than that of the foetal blood, this excess is due to the retention of lipid phosphorus in the maternal blood. The organic and inorganic phosphorus which are required for bone formation are present in the foetal blood in greater concentration than in the maternal blood.

The Limitations of Iron and Calcium Deprivation.—While calcium may be withdrawn from the maternal tissues to the extent described above, the mother does not give up iron with the same freedom. When the respiratory pigment or hæmoglobin is reduced to a point which is dangerous to the mother, foetal death occurs.

IODINE.—The necessity for an adequate supply of iodine for the foetus has been shown by Mellanby. Deficiency of this substance in the maternal diet, particularly during successive pregnancies, leads to

the development of simple goitre in the foetus, with hyperæmia and hyperplasia of the gland, and defective colloid formation. There is no difficulty in the transfer of iodine to the foetal circulation, provided there is an adequate amount in the maternal diet—the amount necessary has been estimated at 0.1 mg. per diem.

Respiratory Exchanges.—The mechanism of respiratory exchange between the maternal and foetal circulations is very simple. Oxygen and carbon dioxide pass through the placental barrier very easily—the osmotic pressure of the two circulations is the same. There must be, however, some catalytic action, as the oxygen has to be split off from hæmoglobin and reunited in the foetal blood. The blood of the umbilical vein is lighter in colour and contains more oxygen and less carbon dioxide than the blood of the umbilical artery. The demonstration of this difference in the oxy-hæmoglobin content by means of the spectroscope, in 1874, was one of the earliest factors in the development of our present conception of the importance of the activity of the placenta.

Vitamins.—Within the past thirty years the recognition of the part played by the vitamins or accessory food factors and the identification of the various vitamins have been the most important contributions to the science of nutrition. The reversion during pregnancy to active tissue growth, not only in the formation of the foetal body, but also for the special development of certain maternal organs, would suggest that the vitamin content of the diet should be very much greater than in the non-pregnant state. Experience has shown that pregnant women are specially liable to develop those diseases which are now regarded as due to *avitaminosis*, such as beriberi, pellagra and osteomalacia. Attempts are being made to establish avitaminosis as an ætiological factor in such obstetrical complications as accidental hæmorrhage, uterine inertia, especially in relationship to postpartum hæmorrhage, and eclampsia. While continued research gives more and more information regarding the properties and the composition of the vitamins, their relationship to the proximate principles of the diet remains uncertain. Whatever that relationship may be, the foetus under favourable conditions receives from the mother a sufficient endowment of vitamins to protect it against such diseases of infancy as anæmia, the hæmorrhagic diseases and rickets. It will be noted that several of the vitamins occur in the same natural media, and that deficiency in different vitamins appears to produce the same result. Deficiency in each of the five vitamin groups described may be associated with abortion or under-development of the foetus, while both vitamins B and C appear to be factors in the prevention of severe anæmia. Further investigations may give more exact ætiological relationships.

Vitamin A.—This fat-soluble vitamin is not destroyed by heat, and is present in large amount in milk, butter, cream, cheese, green

vegetables, carrots, sweet potatoes, tomatoes and bananas. It is present in greatest concentration in liver, and in cod and other fish liver oils. It has been prepared commercially in a concentrated form as Adexolin and Radiostoleum. This vitamin is necessary for growth; laboratory experiments show that gross deficiency produces sterility, and Vogt states that a deficiency of this substance in the diet of pregnant women may result in abnormal or still-born babies. Mellanby states that respiratory infections, including bronchopneumonia, are more frequent during the neonatal period in children when the maternal diet has been deficient in this vitamin. The mothers themselves are specially susceptible to such eye lesions as hemeralopia (night-blindness) and xerophthalmia. The most important property of this vitamin is its power to increase resistance to bacterial infection, and this has been applied to fortifying the individual against puerperal sepsis. In one clinical experiment, including 550 patients, alternate women were given daily for four weeks before term a preparation rich in vitamins A and D. All the women were delivered in hospital; among those patients who had been treated, the incidence of morbidity, based on the B.M.A. standard (p. 634) was 1·1 per cent., while the incidence among the control patients was 4·7 per cent. In those cases in the treated group in which sepsis did occur, it was of a less severe type than in the untreated cases.

Vitamin B.—There are several closely related vitamins included in this group. They are fat-soluble, fairly resistant to heat, and found chiefly in wheat and rice germ, and in smaller amounts in carrots, beans, peas, green vegetables and eggs. They are found in greatest concentration in yeast. This vitamin group has been prepared commercially as Bemax and Marmite.

Vitamin B₁ is described as antineuritic and its absence from the diet is the essential cause of beriberi. During pregnancy, deficiency in this vitamin is associated with the occurrence of polyneuritis and may be a factor in the frequency of constipation (p. 141). The association of this vitamin with the innervation or tone of unstriated muscle has suggested that an insufficient supply may be a factor in the causation of uterine inertia, postpartum hæmorrhage, pyelitis and cholecystitis. Moore and Brodie find that pyloric stenosis and hæmorrhagic disease in the newborn are more frequent when the diet of the mother has been deficient in this substance.

A recent investigation in India showed that in certain Southern States where the diet consists chiefly of milled rice and therefore deficient in vitamin B, the incidence of premature labour is three times more frequent than in certain Northern States where the staple diet is whole wheat.

Vitamin B₂ is described as the antidermatitic vitamin, and its absence from the diet is the essential cause of pellagra. During pregnancy, deficiency in this factor has been associated with the causation

of the pseudo-pernicious or hyperchromic megalocytic type of anæmia (p. 247).

Vitamin C.—This vitamin is water-soluble and easily destroyed by heat. It is found chiefly in the green leaves of cabbage, lettuce and watercress, in potatoes, oranges, lemons and grape-fruit. It is described as the antiscorbutic vitamin, and deficiency during pregnancy gives rise very readily to the symptoms of scurvy.

Deficiency in this factor also causes abortion, the resorption of the foetus, or prematurity. In pregnant guinea-pigs deficiency in vitamin C causes anæmia and incomplete calcification of the dental pulp; in pregnant women it may be a factor in the production of severe anæmia and accidental hæmorrhage.

Vitamin D.—This vitamin is fat-soluble and unaffected by heat; it is found in large amount only in egg yolk and in cod and other fish liver oils. It is formed naturally in the skin from ergosterol by exposure to sunshine, and the small amount present in milk can be increased by irradiation. It is described as the antirachitic vitamin, and controls the deposit of calcium and phosphorus in the tissues. The administration of this vitamin during pregnancy has been found to reduce the clotting time of blood and the amount of bleeding during labour. Deficiency during pregnancy appears to produce a tendency to rickets in the young. Mellanby has demonstrated this tendency very well in dogs. Where the mother had been treated with vitamin C during pregnancy the puppies were resistant to rickets, even when the diet after weaning was designed to cause rickets: where the mother had not been given cod-liver oil, but the puppies had cod-liver oil administered until they were well grown, a change to a diet designed to produce rickets very quickly did so. Mellanby also maintains that deficiency in vitamin C during pregnancy has an unfavourable influence on the calcification of both deciduous and permanent teeth. Preston Maxwell has found that deficiency in this factor is closely associated with the development of osteomalacia during pregnancy (p. 516).

Vitamin E.—This fat-soluble vitamin is unaffected by heat, and occurs chiefly in the germ of wheat and oats. It is present in small amount in milk, butter, egg yolk, fruit and fresh green leaves. It is described as the antisterility vitamin, and in laboratory experiments its absence from the diet causes sterility or resorption of the foetus. In the male, deficiency leads to degeneration of the germ cells in the testes. Recently preparations of this vitamin have been used extensively to prevent abortion (p. 334).

GENERAL PRINCIPLES.—We can observe one general principle in the preparation of the food-stuffs or maternal tissues for incorporation in the foetal tissues. Heape transferred the fertilised ova of one variety of rabbit to the uterus of another variety, and found that the young were born without showing any effect of the foster mother. We must therefore recognise the independence of the germ cells. It is very

seldom that this mechanism can be defeated. When horse serum is injected into the tissues of a pregnant rabbit no trace of the serum proteins of the horse can be demonstrated in the tissues of the foetus; however, when egg albumen is injected in the same way, the foreign proteins can be identified in the foetal tissues. It is only when some protein, absolutely foreign to the tissue proteins of the species, is administered, without being disintegrated and resynthesised by the maternal organs, that the foetus is not able to build up its tissues completely with the proteins peculiar to its own species. The human child is born human, not so much because it is nourished by a human being, as because the germ cells from which it came are human. We know how necessary it is that the individual animal should have the proper series of enzymes to harmonise the building and maintenance of its tissues: the same necessity exists in the ovum from the very earliest stage of its development.

The Total Dietary Requirement in Pregnancy.—Paul Bar's description of pregnancy as a *symbiose harmonique homogene* depended on there being an adequate diet available for the mother. The amount of food taken by a woman during pregnancy need not be greater than at other times, provided that diet is of standard amount and quality. The League of Nations Technical Commission gives 2800 calories as the daily requirement of an adult woman whether pregnant or not. The amount of food taken by the mother during pregnancy appears to have little influence on the weight of the foetus: a mother on an inadequate diet may give birth to large, well-nourished children. About fifty years ago Prochownik reduced the carbohydrates and the fluid intake in the last six weeks of pregnancy with a view to restricting the growth of the foetus and thereby securing an easier labour, but the results of this method are very uncertain. An ample diet in pregnancy is a good foundation for lactation.

In the composition of the diet there should be an increase in the proportion of proteins to provide for tissue-building—the League of Nations Commission recommends 2 grams per kilogram of body-weight. This need should be remembered when toxæmic patients are put on to a restricted diet—the patient will suffer if the restriction is maintained too long (p. 215). Not less than one-third of the protein should be from animal sources, as animal proteins contain such essential amino-acids as tyrosine, tryptophane and cystine. Reference has already been made to the need for calcium, phosphorus, iron, iodine and vitamins. In his Cantor Lectures on Nutrition and National Health, Sir Robert McCarrison states that a well-balanced diet during pregnancy would contain 70 grams of protein, of which one-third must be derived from animal sources: an abundance of all vitamins, including vitamin D, which should be provided in the form of cod-liver oil so as to avoid the risk of overdosage, and also to secure an additional source of iodine: 2 grams of calcium: 1.6 grams of

phosphorus : 0.3 grams of magnesium : and 20 milligrams of iron. *The best diet for expectant mothers is one made up of whole-grain cereals, milk, milk products and eggs, with fresh green vegetables and fruit in abundance.*

THE MATERNAL EXCRETORY SYSTEM

During pregnancy, the kidneys of the mother have to deal not only with her own waste products, but also with those produced by the vital processes of the foetus. A considerable strain is thereby thrown on the kidneys ; in many cases new kidney lesions are produced, while in others, old lesions, which had become sufficiently repaired to cope with the normal processes of the mother, give way under the demands of pregnancy.

Changes in the Urinary Tract.—The urinary tract is subject to changes during pregnancy from : (a) altering relationship of the pelvic organs ; (b) variations in muscle tone. By the end of the second month, loss of tone and slight dilatation can be demonstrated in both ureters in many patients, associated with the lower tone of all visceral muscle during this stage of pregnancy. The lowered tone may persist or get worse until the end of the sixth month, but from then onwards there is a steady improvement until labour, after which there is very often, especially on the right side, a very sharp loss of tone, from which a complete recovery is not made for several months. This primary factor affects both ureters equally, but a new factor appears by the end of the fourth month, when the uterus has become an abdominal organ. The weight of the uterus now tends to compress the atonic ureter as it crosses the pelvic brim, and further dilatation takes place about that level. This is much more marked on the right side where the ureter crosses further from the middle line and is more exposed to pressure : below the pelvic brim on this side, dilatation can no longer be demonstrated—stasis occurs above this level. On the left side, while the dilatation above the pelvic brim is usually less marked, it does continue in lesser degree down into the pelvis. In a primigravida with muscular abdominal walls, the ureters may be compressed against the psoas muscles and dilatation may first appear at a higher level than the pelvic brim.

While dilatation and stasis have been shown to be closely related, dilatation can exist without stasis, and stasis may be present without dilatation. Baird has shown that stasis begins early in pregnancy, reaches its maximum as a rule at the sixth month, and diminishes near full term. On the right side, as with dilatation, the stasis in the sixth month is greatest in the ureter, and becomes greater in the renal pelvis and calyces near full term, while the elimination from the ureter has improved. The effect of these changes on renal function differs at various stages of pregnancy. At the sixth month, though there is

marked disturbance of ureteral function, the renal function may be better than later when the function of the ureter has improved, as owing to the increased pressure of the uterus and the improved tone of the ureters the intra-ureteric pressure rises and adversely affects the function of the kidney. At the sixth month there is good excretion by the kidney and delay in emptying the ureter; whereas later the excretion by the kidney is relatively poor and there is less stasis in the ureter. As the effect on the left kidney is almost negligible, symptoms of complete renal deficiency seldom develop during pregnancy. The disturbance of renal function by intra-ureteric pressure may be a factor in the ætiology of renal toxæmias (p. 211), whereas the urinary stasis favours bacterial invasion and the development of pyelitis (p. 262).

Polyuria.—While the volume of urine at any time depends to a great extent on the fluid intake or on the permeability of the kidneys, in pregnancy there is usually a certain degree of polyuria—the amount excreted per day usually lies between 1000 and 1500 cubic centimetres.

Frequency of Micturition.—In addition to the increased volume, there is very often frequency of micturition, especially in the early months of pregnancy. While this may be due to the pressure of the acutely anteverted uterus on the bladder, it may be associated with alterations in the composition of the urine—to hyperacidity or to increase in the urates or phosphates. It does respond in many cases to the copious administration of alkalis. There is still another possible cause for this frequency—a mild infection of the urinary tract.

Albuminuria.—There are also changes in the solid constituents of the urine. In about 5 per cent. of women in whom there has been no previous kidney lesion, there appears a slight haze of albumin which may never increase, but which in a few cases is the early indication of the development of a pre-eclamptic toxæmia. This condition is probably a form of “pregnancy kidney,” due to some toxin circulating in the blood and affecting the renal epithelium (p. 209).

Sugar in the Urine.—During the routine examination of the urines of pregnant women, reduction of Fehling's or Benedict's solution often occurs, especially in the later months of pregnancy. In most cases the sugar present is lactose, due to a premature activity of the mammary gland, which converts the circulating glucose into lactose. *Lactosuria* is specially common during the puerperium, and reaches its highest point about the third day of the puerperium, when the breasts are usually very much engorged.

It is a matter of the greatest importance to make certain that the sugar present is lactose. It may be differentiated from glucose by the ozazone test, the crystals of glucozazone and lactozazone being easily identified. Differentiation may also be made by the polarimeter test, because though both glucose and lactose are dextro-rotatory, the angles of rotation are quite different. The most easily applied test for general

use is the fermentation test : glucose is fermented by yeast, while lactose is not. The urine, having been boiled to arrest bacterial action, is put up with yeast, and allowed to stand for several hours in a warm place. At the end of this period the urine will still have the power of reducing Fehling's solution if lactose is present, whereas glucose is broken up by the yeast and the Fehling's solution will remain unaltered.

While the serious prognosis in pregnant women suffering from true diabetes will be referred to later (p. 268), not all cases of glycosuria are due to a definite organic lesion. During pregnancy there are certain changes in the activities of various organs, particularly in the ductless glands. These changes produce several recognised disturbances of the normal metabolic processes.

Alimentary Glycosuria.—In a healthy individual the level of sugar tolerance is high. Large quantities of carbohydrate, up to 120 grams of glucose, may be taken without any sugar appearing in the urine. During pregnancy this tolerance is very much diminished, due to a lowering of the renal threshold for glucose or perhaps to increased activity of the pituitary gland : the consumption of a modest box of sweetmeats may give rise to the temporary appearance of glucose in the urine. One observer was able to produce glycosuria in 80 per cent. of a series of pregnant women by simply increasing the amount of sugar ingested. This glycosuria is usually discovered accidentally during the routine examination of urine. None of the usual associated symptoms of true diabetes are present—thirst, wasting, and marked polyuria. The sugar content of the blood is normal, and the sugar disappears quickly when the diet is regulated. The prognosis in this type of glycosuria is good : the ordinary level of sugar tolerance is regained at the end of the pregnancy.

Renal Glycosuria.—Occasionally cases of this form of glycosuria, in which the renal epithelium is abnormally permeable to glucose, are found among pregnant women. In these cases excretion takes place so rapidly that the blood sugar is kept below the normal level. The sugar content of urine is less than 2 per cent., and these cases can be identified by the fact that the glycosuria is associated with a blood sugar content of less than 0.1 per cent. There is no thirst, wasting, or marked polyuria. Complete arrest of this glycosuria is very difficult, but the patient suffers very little disturbance. The prognosis is quite good so far as pregnancy is concerned.

Glycosuria with Pseudo-toxæmia.—Crook has described still a third type of glycosuria in which sugar appears in the urine about the sixth month of pregnancy. It is often accompanied by symptoms usually associated with some form of toxæmia of pregnancy, and may recur in succeeding pregnancies. It is especially associated with cases in which there has been severe early morning sickness which has subsided. In the later months there may be cedema, not associated with albuminuria. This type may be found in association with

hydramnios. Crook suggests that this form of glycosuria may be a precursor of diabetes mellitus.

The graver forms of glycosuria are dealt with on page 268.

Alterations in the Nitrogen Content of the Urine.—Quantitative analysis reveals certain changes in the proportions of the various nitrogen-containing substances which appear in the urine. These changes are more easily explained when we remember that the ovum requires nitrogen for the formation of its own tissues. A careful analysis of the food intake, and of the nitrogen excreted in the urine and the faeces in pregnant women from the fourth month onwards, shows that there is a considerable retention of nitrogen, which retention, as the pregnancy advances, remains proportional to but greater than the needs of the foetus. This nitrogen retention occurs principally in that portion of the nitrogen which would otherwise be excreted as urea. The result is that the urea nitrogen is diminished in amount. Owing to this diminution of urea nitrogen some of the other nitrogenous bodies appear to be increased in amount. Ammonia nitrogen, purin nitrogen and undetermined nitrogen are relatively increased, though the absolute amounts vary little from normal. The amino-acid nitrogen is slightly increased, especially in the early months of pregnancy. Polypeptid nitrogen can be identified in the urine, and creatinin appears during the later months.

These changes indicate very clearly that the foetus is built up from the food ingested rather than from the formed maternal tissues. The endogenous metabolism is very little disturbed : the changes take place in the exogenous metabolism. Further proof of this is found in the examination of the sulphur bodies in the urine : the inorganic sulphate sulphur, characteristic of exogenous metabolism, is reduced like the urea nitrogen ; the neutral sulphur, characteristic of endogenous metabolism, is only relatively increased.

The increase in the undetermined and polypeptid nitrogen may be due to the activity of the placenta. We have seen that digestive and absorptive processes go on in the placenta ; resulting from this, certain rejected substances enter the circulation and reach the kidney directly for disposal. Such rejected substances, in the process of intestinal absorption, would be dealt with by the liver and deamidised there before reaching the kidney for excretion. '

Other Urinary Contents.—The variations in sulphur have been mentioned in the last section. Calcium and phosphorus, which are essential to the formation of foetal tissues, are retained like nitrogen. The other inorganic constituents vary in the same sense.

Formerly, very great importance was attached to the appearance of acetone in the maternal urine. It was regarded as a certain indication of foetal death. This view has been shown to be quite erroneous. The ready appearance of acetone bodies simply shows the extremely unstable character of carbohydrate and fat metabolism during pregnancy,

and the essential need for carbohydrate feeding. Foetal death may occur without acetonuria, and *vice versa*. Acetonuria may be found in a large number of normal pregnancies with no pathological significance. A diet poor in carbohydrates leads to the excretion of acetone bodies in a normal pregnant woman, while in a non-pregnant woman on the same diet none appear. Almost every labour, and especially all protracted labours, are associated with an acetonuria, due most probably to the severe muscular effort, associated with the abstention from food characteristic of that period.

A most important constituent of the urine in pregnancy is the hormone, closely resembling that of the anterior lobe of the pituitary gland, which is present in high concentration (p. 63). This hormone has a very potent action on the ovaries of immature animals, particularly mice and rabbits, and the injection of small amounts of urine into such animals, to see whether the characteristic changes are produced in the ovaries, forms the basis of the Aschheim-Zondek test for pregnancy (p. 167).

THE DUCTLESS GLANDS

The Thyroid Gland.—Reference has already been made to the close relationship between this gland and the sexual processes. In a very large proportion of women—in 80 per cent., according to some records—an appreciable enlargement of the thyroid occurs during pregnancy. This enlargement is due to a true hyperplasia of the adenomatous tissue, an increased blood supply and the formation of new follicles. Those changes indicate an increase in function, such as would be associated with the increased basal metabolic rate of pregnant women (p. 157), and an increase in the iodine content of the blood. Hypertrophy appears about the fourth month and in a few cases has become so great as to cause severe discomfort in the later months and in labour; cases have been reported in which the dyspnoea was so great during labour as to require a tracheotomy.

In pregnant dogs from which the thyroid was removed the puppies showed enormous hypertrophy of the thyroid gland, as if to compensate for the deficient maternal secretion. When the thyroid was removed from pregnant rabbits, pregnancy was prolonged and the young at birth were undersized and poorly developed, with evidence of increased thyroid activity.

In the earliest investigation of the association of thyroid enlargement and pregnancy, it was observed that a large percentage of the women in which the thyroid was not enlarged showed albuminuria, but time has failed to establish a definite relationship between the thyroid changes and renal function. Some of the minor disturbances of pregnancy, such as insomnia and tachycardia, may be due to slight hyperthyroidism (p. 189).

Parathyroid Glands.—Examinations of the parathyroids in pregnancy

have shown hypertrophy of the glands. The chromophile cells are increased in number and are better outlined. The parathyroids are intimately associated with the metabolism of calcium, and the changes noted above in the calcium content of the tissues referred to may be due to the parathyroids. In dogs in which a partial parathyroidectomy had been performed, and which had recovered and were leading an apparently healthy life, pregnancy was found to precipitate the development of tetany, the lesion which is characteristic of parathyroid insufficiency. The importance of this gland in relation to the tetany of pregnancy will be described later (p. 272).

Thymus.—While the thymus gland has usually atrophied soon after puberty, it may persist. Should pregnancy occur, the gland atrophies during pregnancy, to regain its previous form during the puerperium.

Pituitary Gland.—(a) *Anterior Lobe.*—This lobe undergoes hypertrophy to about twice its normal size, resuming the original form at the end of pregnancy. Disturbances of vision have been described as resulting from the pressure of this large lobe upon the optic chiasma. The main factor in the hypertrophy is an increase in the size and number of the *Haupt-Zellen* or *chief cells*. These large ovoid cells, probably derived from the chromophobe cells, are so characteristic as to be described as *pregnancy cells*. A few of them may be identified in the tissue of the anterior lobe after pregnancy, and their presence could be accepted as a proof of pre-existing pregnancy. Recently Sheehan has described very important lesions in this lobe as occurring during the puerperium. In certain fatal cases in which death was ascribed to excessive blood loss resulting from placenta prævia, accidental hæmorrhage or postpartum hæmorrhage, to acute septicæmia or merely to obstetric shock, extensive necrosis of the anterior lobe was discovered. The exact ætiology of this lesion has not yet been determined. In cases in which the necrosis does not prove fatal the patients afterwards present the clinical picture of Simmonds's disease, including atrophic changes in the reproductive organs.

The cardinal importance of the gonadotropic hormone, secreted by this lobe, in the control of ovarian activity, has already been described (p. 62). The enormous increase in the functional activity of the reproductive organs would account for the great hypertrophy of the lobe during pregnancy. The large amount of the gonadotropic hormone secreted and excreted during pregnancy is the basis of the Aschheim-Zondek test for pregnancy (p. 167). Removal of the gland during pregnancy is almost always followed by abortion. The anterior lobe is also responsible for the non-œdematous thickening of the features and the slight enlargement of the hands and feet which occur in some women during pregnancy. The changes produced may be so marked as to suggest an early case of acromegaly (p. 62), but the signs disappear at the end of pregnancy.

(b) *Posterior Lobe*.—The posterior or infundibular portion does not undergo hypertrophy during pregnancy. The oxytocic hormone secreted in this lobe produces most vigorous contractions of uterine muscle, but until the later months of pregnancy the uterus appears to be relatively insensitive to this hormone. Experimental work shows that this inhibition is probably due to the action of the progesterone secreted by the corpus luteum (p. 59). The researches of Knaus indicate that the susceptibility of the uterine muscle to the oxytocic hormone is very much increased towards the end of pregnancy. The uterus appears to be made more sensitive to the oxytocic hormone by œstrone or œstradiol. The oxytocic hormone is now used extensively to stimulate uterine contractions in the induction of labour (p. 734) in certain cases of uterine inertia during labour (p. 427) and in the control of postpartum hæmorrhage. For this purpose the commercial preparations of the hormone have been standardised.

The antidiuretic hormone of the posterior lobe may be of importance in the ætiology of eclampsia (p. 226).

The Suprarenal Glands.—The cortex of the suprarenal glands shows definite hypertrophy, especially in the zona fasciculata, during pregnancy. The lipid content of the gland is very much increased, and may be the source of the large lipid content of the blood during pregnancy (p. 140). The abnormalities in pigmentation, referred to later, may be due to irregular function of the suprarenal glands.

THE CALCIUM-CONTAINING TISSUES

During pregnancy several observers have described irregular deposits of newly formed bone on the inner surface of the skull, particularly along the middle meningeal sinus and the longitudinal sinus. These deposits have been called “puerperal osteophytes.” Again, the skeleton has been found to undergo changes comparable to a slight degree of osteomalacia (p. 516). The effect of pregnancy on the teeth has undone, in many women, most careful dental handiwork. “Fillings” become loosened and perhaps lost: but no attempt should be made to repair the teeth, except temporarily, until pregnancy is over.

Such changes occur owing to the difficulty which many women have in supplying enough calcium for the fœtus, because of the unsatisfactory nature of their food. Bar has calculated that during the last two months of pregnancy the fœtus requires 0·64 gram of calcium oxide per day, whereas Orr estimates that the average calcium intake among the pregnant poor in England is 0·37 gram daily. As a pint of milk contains about 0·5 gram of calcium, one quart of milk per day would give an ample amount to supply the needs of the fœtus and provide a reserve. The limitations of calcium deprivation have been described (p. 144).

The mobility of the pelvic joints which is necessary for labour is probably secured by some hormone activity associated with the softening of all the pelvic tissues (p. 121).

PIGMENTATION

The degree of pigmentation occurring in pregnancy varies considerably. Most women show marked pigmentation along the *linea alba*, and in many the pigmentation of the face and neck, forming the *chloasma uterinum*, is a noticeable feature. This pigment is deposited in the papillary layer of the skin, and is made up from an iron basis. It is probably derived from the destruction of maternal hæmoglobin necessary to supply the foetus with sufficient iron, and the hypertrophied cortex of the suprarenal gland is likely to be associated with its distribution.

THE NERVOUS SYSTEM

In many women pregnancy is associated with an increase in the irritability of the nervous system. Formerly, morning sickness was attributed to a reflex nervous disturbance, but it is much more likely to be due to a mild toxic disturbance, the ætiology of which will be considered with the toxæmias of pregnancy.

The degree of nervous disturbance varies with the maternal metabolic response to pregnancy. In those women who digest better and enjoy improved general health throughout pregnancy the nervous irritability is seldom present. In others, changes in temperament are quite obvious; strong antipathies may appear and cause the patient's relatives considerable anxiety. The disturbance may take the form of intense longings for unusual varieties of food. The nervous change may be so pronounced as to be described as a form of hysteria. Insomnia is sometimes very troublesome, and its treatment may cause the physician a great deal of anxiety.

PREPARATION FOR LACTATION

The anatomical changes in the breasts have been described in Chapter VI. The glands do not begin to secrete under normal circumstances until the puerperium, but in some cases a watery secretion flows from the breast from the early months of pregnancy. The secretion of the *mammæ* is not dependent upon the control of the central nervous system, because experiments on rabbits have shown that the mammary gland can be transplanted on to the tip of the ear without having its secretory activity interfered with. The changes in the breasts during pregnancy appear to be produced by hormones secreted by the ovary and by the anterior lobe of the pituitary

gland. The hypertrophy of the gland tissue is produced by the ovarian hormones, but the phase of actual secretion is dependent on the prolactin hormone of the anterior lobe, which does not become effective until after parturition (p. 155). Neither of these agents is effective early in pregnancy or if the foetus dies *in utero*. The clinical effect of suckling in stimulating lactation may be due to a reflex action on the anterior lobe of the pituitary gland. In some cases of ovarian or uterine tumours without pregnancy, milky fluids can be expressed from the breasts.

The mammary glands towards the end of pregnancy begin to shed the epithelial cells from the acini, thus forming the lumina of the acini. These shed cells, which have undergone fatty degeneration, form the corpuscles which appear in the colostrum. This colostrum, a thin, yellowish fluid containing the corpuscles referred to, forms the substance which can be expressed from the breasts during pregnancy, and which flows during the first two or three days of the puerperium. It has a high fat content and acts as a mild purgative for the child.

By the third or fourth day of the puerperium the colostrum has been almost completely shed, the breasts are greatly engorged and the secretion of true milk begins. The transportation of the constituents, caseinogen, lactalbumen and the mineral salts, from the maternal tissues into the ducts of the glands, is due to the secretory activity of the gland epithelium.

THE TOTAL INFLUENCE OF PREGNANCY UPON MATERNAL METABOLISM

The changes which take place in the individual organs and systems of the mother during pregnancy have been described. We have now to consider the total effect of pregnancy upon the metabolism of the mother. This problem has been carefully investigated in some of the lower animals, where the period of gestation and the control of intake and output have made such a study possible. In human beings the records are incomplete, because the long period of gestation and the difficulty of keeping women on standard diets for such a long time present very great difficulties.

OBSERVATIONS ON ANIMALS.—Some of the best investigations have been carried out on dogs and rabbits. In both, the results are comparable. In the case of the dog, gestation lasts for sixty days, and for the purpose of this study that period may be divided into four phases of fifteen days each. In the first phase, the dog proceeds to store up nitrogen in excess of what is actually necessary for the formation of the embryo and the associated increase in size of the local organs. In the second phase there is a change in the picture; the animal loses nitrogen more quickly than it can store it, and consequently the end of the second phase often finds the animal reduced in weight below that with which

it commenced its pregnancy. The third and fourth phases are continuous and represent a period of steady gain to the maternal organism. On an ample diet and under healthy conditions the animal, throughout the third and fourth phases, stores up nitrogen, not only in proportion to, but in excess of, that which is necessary to build up the foetal tissues, the placenta, the increase of the tissue in the uterus and the mammary glands. At the end of pregnancy the mother has actually gained in weight in the whole of her tissues. She has at her disposal a reserve store of nitrogen which may enable her to carry out the function of lactation without detriment to her tissues. In rabbits exactly similar phases can be identified.

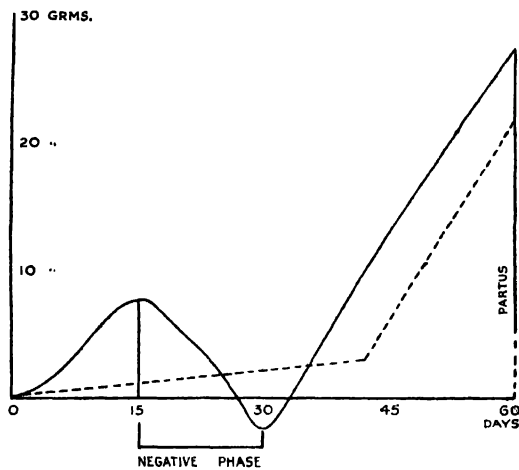


Fig. 79.—The Course of Nitrogen Retention during Pregnancy in a Dog (diagrammatic, after Bar). The continuous line shows the total Retention of Nitrogen by the Mother from the beginning of Pregnancy. The dotted line shows the total amount of Nitrogen required by the Foetus as development proceeds. The incidence of the Negative Phase is shown.

The most interesting and important part of this study is the second phase. During that period, Bar has noticed that the animals may suffer from gastro-intestinal disturbances and unmistakable signs of malaise, all of which disappear when the third phase commences. Most important of all is the fact that the change from the second to the third metabolic phase corresponds, in time, to the stage at which in these animals the development of the placenta is completed.

When we compare these observations with clinical observations on women, we are at once struck by the fact that this second phase is the period in human gestation during which morning sickness occurs. It is also at this point that more pathological manifestations, such as hyperemesis gravidarum, neuritis, herpes, pruritus and excessive salivation occur.

INVESTIGATIONS ON WOMEN.—Owing to the difficulties referred to above, the observations on pregnant women do not cover the whole period of gestation. One or two cases have been recorded from the third month, and many in the later months. In none of the cases recorded was an actual nitrogen loss found; but in the third month cases, the nitrogen gain in that month was very small when compared with the gain in the later months of pregnancy. In reading those results along with the actual loss found in animals, we must remember that these animals have a much greater strain thrown on the organism in pregnancy than human beings. In the human race the mother is required to elaborate not more than 9 per cent. of her body-weight in nine months, whereas the dog may require to elaborate 25 per cent. of its body-weight in sixty days.

All the records of the later months of pregnancy show a uniform retention of nitrogen proportional to, but greater than, the needs of the foetus and its associated structures. In women we are justified in assuming that, so far as the second half of pregnancy is concerned, where the mother is healthy and the supply of food suitable and adequate, she ends her pregnancy with a credit balance. From the biological point of view, therefore, the developing ovum acts as a stimulus to the metabolic processes of the mother and leaves her with a greater reserve of tissue-forming material than she had before her pregnancy commenced.

THE NEGATIVE PHASE IN PREGNANCY.—The second phase of pregnancy described above is so characteristic that it has received a definite name—the *negative phase*. To what is this negative balance or period of excessive katabolism due? Several theories have been propounded. Bar suggests that the organism becomes oversaturated with nitrogenous bodies in the first phase, and this supersaturation results in a too great elimination in the second phase. It may be, again, that the proteins of the circulation or of the maternal tissues have to be broken down further than we had imagined, before they can be built up again into the tissues of the foetus, and that this dissociation of proteins leads to many parts of the molecules being rejected and excreted. Most light can be thrown on this problem by considering the end point of the phase—the completion of the formation of the placenta. We have seen already that one of the functions of the placenta is the protection of the mother against the activities of the trophoblastic villi (p. 134). The activity of the trophoblast is associated with the destruction of maternal tissue by ferments; the early proteolytic ferment has been described (p. 132). When we note, therefore, that this negative phase comes to an end when the trophoblastic villi lose their burrowing power, there seems good reason for believing that this negative phase is due to the unrestricted or incompletely restricted influence of the foetal cell activities or ferment activities, which cause an excessive loss of the maternal tissues.

DOES A NORMAL PREGNANCY CAUSE AN ACIDOSIS IN THE MOTHER ?
—Certain of the changes in the composition of the urine in a normal pregnancy resemble those found in a mild acidosis. Creatin may appear in the urine, and the amount of ammonia is increased. This increase in the ammonia was formerly attributed to hepatic insufficiency, as shown by incomplete deamidation, but gross hepatic lesions may occur without any increase in the ammonia output—the ammonia excretion may remain unaltered in eclampsia. An increase in the ammonia of the urine is most typically associated with starvation of the mother and her depletion by the foetus. The significance of ammonia is merely as an index of the depletion of fixed bases. In actual fact the increase in ammonia excretion in a normal pregnancy is only relative, due to the decrease in the nitrogen usually excreted as urea.

The evidence for the slight acidosis indicated by the appearance of creatin must be searched for in another direction. A slight excess of organic acid in the circulation could be compensated by the removal of a little more carbonic acid from the blood, while a slight relative acidosis due to diversion of bases to the foetus would produce the same net effect indirectly by diminishing the carbon-dioxide-combining power of the blood. Several observers have reported a lower alveolar tension of carbon dioxide in pregnant women, and state that it occurs as early as the first missed period. The slight decrease in carbon-dioxide-combining power of the blood, as compared with the value which is restored after parturition, is exactly compensated by the greater activity of the respiratory mechanism for removal of the carbon dioxide. This increased activity seems to be due to an increased sensitiveness of the respiratory centre to the presence of carbon dioxide. The slight acidosis which seems to occur, therefore, is compensated mechanically by the respiratory apparatus. The actual tendency to acidosis appears to be due to the deviation of inorganic bases to the foetus, but compensation is so complete that the hydrogen-ion concentration of the blood remains unaltered at about 7·40.

A very definite acidosis occurs in prolonged labour, and this tends to favour fatigue and lower the resistance of the organism to infection and to obstetric shock (p. 571).

Basal Metabolism.—Pregnancy is associated with an increase in the total metabolism of the mother. The oxygen absorption at the end of the eighth month is 17 per cent. higher than at the end of the third month. In the normal woman at term the basal metabolic rate is about 4 per cent. higher than in the normal non-pregnant woman in complete sexual rest. During the puerperium the heat production per unit of weight is about 11 per cent. higher than for the normal non-pregnant woman, and 7 per cent. higher than for the same woman at term. Investigations have shown that the basal metabolic rate is always increased in pregnancy, sometimes up to 30 per cent. above the

normal non-pregnant level. While variations in basal metabolism are closely associated with thyroid activity and we know that the thyroid gland in pregnancy is hypertrophied (p. 271), the needs of the growing ovum may be taken as the primary cause.

THE ENERGY OF DEVELOPMENT

From what source is the energy which is necessary to secure the growth and the maintenance of the foetal tissues obtained? The study of the respiratory quotient in the hen's egg indicates that fat is the material which is oxidised in the development of the chick. Analysis of the blood in the umbilical vein and artery of the sheep shows that carbohydrates, the most readily diffusible of all the food-stuffs, form the source of energy. This has been confirmed in other mammals.

When the respiratory exchanges of the mother and child before and after birth are studied in the calorimeter, it is found that the requirements are practically equal. The increase in oxidation in the child's body, when it passes from the warm environment of the mother's uterus to the colder environment of the outside world (supplying its oxygen now by its own lungs instead of from the mother's placenta), practically compensates the oxidation of the accessory structures, placenta, uterine wall, and amniotic fluid, which supported it in the uterus. The demands upon the mother's digestive system are not greater. She is called upon to supply the same amount of energy in potential form to herself and child immediately after parturition which she did to herself and child immediately before.

The study of the respiratory quotient in the newborn is even more interesting. There, again, the source of energy is carbohydrate. The quotient falls rapidly after a few hours; and by the second day, if no food has been given, it has reached the level of fat combustion, indicating a certain degree of starvation acidosis. The child is born with a sufficient supply of carbohydrates to meet its energy requirement for a portion of the first day, but this supply is quickly exhausted, and the child should be fed very early.

Prolonged labour or the administration of anæsthetics increases the sugar-content of the maternal blood, and consequently of the foetal blood, and therefore increases the carbohydrate available for the newborn child.

CHAPTER VIII

SIGNS AND SYMPTOMS—DIFFERENTIAL DIAGNOSIS OF PREGNANCY

THE diagnosis of pregnancy may be said to have been revolutionised in the last ten years by the Aschheim-Zondek and Friedman tests of the urine. A degree of certainty equal to almost 98 per cent. can now be obtained by their employment as early as the third to fifth week of pregnancy, whereas formerly such certainty could never be reached much before mid-term. Furthermore, radiography has been found to be of great assistance in many instances.

To be completely reliable these biochemical tests and radiological examinations must be conducted by an expert and there are many circumstances in which recourse to them cannot be made. In such cases a diagnosis must rest on the clinical investigation of symptoms and signs. While a provisional diagnosis, sufficient for most ordinary purposes, can usually be reached without difficulty, very great difficulty may be encountered in the early weeks or in cases associated with pelvic tumours and other complications unless biochemical tests are employed.

For practical purposes the symptomatology (and in this it is convenient to include both symptoms and signs) is best divided into two periods corresponding to the first and second halves of pregnancy.

The First Period is characterised by subjective and therefore not wholly reliable symptoms, and by signs which it may be difficult to recognise. At the best, therefore, they can justify only a presumptive or probable diagnosis. No single symptom or sign is sufficient by itself to warrant an opinion; only when the clinical phenomena harmonise with one another to form a characteristic syndrome is a diagnosis justified. The most fruitful source of error lies in placing too much trust in the patient's own statement of her symptoms—the subjective phenomena—and in failing to make an examination to ascertain the physical signs—the objective phenomena—upon which ultimately the diagnosis must be based.

The Second Period is characterised by more easily recognisable physical signs which give certainty in diagnosis, and in the absence of complications little difficulty arises as a rule during this period.

I. SYMPTOMATOLOGY OF PREGNANCY IN FIRST PERIOD

Subjective Symptoms.—(1) The patient is first questioned as to the date of her last menstrual period. A “missed period” is usually the first indication which makes her suspect pregnancy, and it is undoubtedly a valuable indication, especially in healthy women who have previously been regular.

Inquiry must, however, be made as to any previous tendency to irregularity. Amenorrhœa, lasting for many months, is not uncommon in anæmia, chlorosis, phthisis or other debilitating disease. When amenorrhœa is due to some pathological condition the usual history is one of gradual and progressive diminution in quantity before complete cessation, whereas the amenorrhœa of pregnancy starts abruptly. It is possible that fear of pregnancy in the unmarried, or great desire for pregnancy in childless women, may produce amenorrhœa; in the former the symptom never lasts more than a few weeks; in the latter it is generally when the menopause is near (see “Pseudocyesis,” p. 177). Rarely a woman may menstruate after pregnancy has begun. This is possible for the first three months, before the decidua capsularis and decidua vera have completely fused. Such menstruation is characterised by its diminished quantity as compared with the usual periods, and this is a point to be specially inquired into. Bleeding due to a threatened abortion often occurs at times corresponding to the suppressed menstrual periods, and may be misinterpreted as “menstruation.” For practical purposes it may be taken as a rule that a woman who has her regular periods is not pregnant. A woman may sometimes wilfully give false information as regards her periods, believing or knowing herself to be pregnant, but concealing the fact and feigning illness in the hope that some local treatment, which may induce abortion, will be carried out by the unsuspecting doctor.

Pregnancy occasionally occurs during the amenorrhœa of lactation, and rare cases are recorded where it has begun before menstruation has been established, and even after the menopause.

(2) Sympathetic symptoms consist chiefly in digestive troubles, of which *morning sickness* is the chief. But other conditions may also be associated with sickness in the morning, *e.g.* chronic alcoholism; and a few women experience nausea and even vomiting at the beginning of the monthly periods (p. 53).

The morning sickness of pregnancy generally begins soon after the first period missed, and may continue till about the fourth month. It usually occurs on awakening in the morning, or just after getting up, and mucus or bilious matter is got rid of. Sickness may continue through the day, and result in the vomiting of food. Sometimes more or less constant nausea without vomiting may be experienced, which is often more trying. Within ordinary limits, the general health is not much affected, but it should never be disregarded, and every effort

should be made to stop or to alleviate it (p. 199). Sickness is present in more than half the cases of early pregnancy, and is always a suspicious symptom of pregnancy.

Other sympathetic troubles may also be associated with early pregnancy, such as eccentricities, chiefly in regard to food, taste, smell, etc., also changes in temperament of a passing nature. Irritability of the bladder is a frequent concomitant of early pregnancy, owing to the increased weight of the uterus. Experienced multiparæ often attach considerable importance to these symptoms when they occur, but they are never of themselves sufficient to establish a diagnosis of pregnancy.

Inspection.—The changes in the mammæ in primigravidæ are of great value and begin to manifest themselves from the seventh week. They comprise swelling and tenderness of the breasts, increased development of the parenchyma, erectility of the nipples, enlarged veins, “tubercles of Montgomery,” and areolar pigmentation. From the twelfth week traces of a serous exudation may be observed in the form of dry scurfy scales on the nipple, and may be expressed by compressing the breast from the base towards the nipple. In multiparæ the breast signs are not of the same significance, as, after the first pregnancy, pigmentation usually persists, and fluid can generally be expressed from the nipple, even after years of sterility. Furthermore, in some multiparous women the breasts may enlarge and become sensitive during menstruation, and milk may occasionally be expressed. Lastly, secretion may very occasionally be present in the breasts of women suffering from ovarian tumours (p. 1017).

Abdominal inspection gives little information in the early weeks. The lower abdomen is often flatter than usual in the first three months, and it is not until the fourth month that slight convexity shows itself. This is more evident to begin with in multigravidæ, whose abdominal walls are generally more lax than in primigravidæ. The umbilicus is usually retracted and deeper in the first three months; it then gradually becomes shallower, till ultimately, in the last month, it may be everted and protrude.

Pigmentation of the face and neck (chloasma) and of the abdominal wall (linea nigra) and the secondary areola of the breasts are not apparent until about the sixth month, as also cutaneous striæ (striæ gravidarum) of the mammæ and abdomen (p. 127). In women with very elastic skin the striæ may be absent.

Palpation.—From the twelfth week onwards one can often palpate the fundus uteri through the abdomen as a mesial, globular, soft, elastic, movable swelling, without tension or tenderness. By the sixteenth week it has usually reached about half-way between the symphysis pubis and the umbilicus, and by the twentieth week to a finger-breadth below the umbilicus. There are, however, considerable slight variations, depending upon the amount of liquor amnii and the state of the patient's bladder and rectum.

Vaginal Examination.—The cervix early becomes softer to touch, and this softening becomes more and more marked as pregnancy advances, till at the end of pregnancy it may be difficult for the inexperienced examiner to distinguish the cervix from the vaginal walls. The *apparent* shortening of the vaginal portion of the cervix is really due to its greater softness and to the widening out of the lower part of the uterus. There is actually no diminution in length, but a slight increase associated with the general hypertrophy of the uterus.

The vaginal fornices are normally empty before pregnancy, but, by the fifth week, the lower part of the uterine globe can be palpated with the finger through the fornices. There is increased secretion in the vagina and increased pulsation in the lateral fornices (*Osiander's sign*). Vaginal pulsation may, however, be felt apart from uterine pregnancy, as in salpingitis, and particularly in tubal pregnancy.

Darkening in colour of the mucous membrane of the vagina can generally be observed as early as the second or third month. This is known as *Jacquemier's sign*, but may be present in other conditions which give rise to pelvic congestion. There may also be some varicosity of the veins in the neighbourhood of the vulvar opening (*Kluge's sign*). The papillæ of the vagina become enlarged and may give it a roughened feeling.

Bimanual Examination.—By this method of exploration it is possible to give a presumptive opinion as to the existence of pregnancy in the early months. The enlargement, the consistency, globular shape and *increased anteflexion* of the body of the uterus are characteristic, as also is its frequent asymmetry of growth. Its elasticity, or “early fluctuation,” in the early weeks can usually be well made out, as also occasional contraction or hardening of its walls, appreciable to the educated touch from the twelfth week (p. 175). The manner in which the examination should be made has been described already (p. 111).

Hegar's sign is of the highest importance as an aid to diagnosis. It consists in the recognition of the softened isthmus of the uterus, between the cervix below and the enlarged body of the uterus above. If this region is compressed between the abdominal and vaginal fingers, the fingers of the two hands seem almost to meet, and there appears to be a breach of continuity between the body and the cervix (see Fig. 80). This phenomenon, which is found only in pregnancy, can be recognised from about the eighth to the fourteenth weeks. When the uterus is lying forward the external fingers are pressed down behind the body of the uterus, and the vaginal fingers are pressed up in front of the cervix into the anterior fornix. When the uterus lies backwards the external fingers are pressed in just above the symphysis and the vaginal fingers lie in the posterior fornix.

Fœtal Ballotement, repercussion or passive fœtal movement may sometimes, though rarely, be recognised as early as the fourth month. The fœtus suspended in the liquor amnii can be tossed, so to speak,

between the fingers of the two hands of the examiner by alternate jerky movements, and gradually comes to rest again in the most dependent part of the uterus, where it can be felt settling down on the fingers in the vagina with one or two gentle taps or "stotting" movements. For internal ballottement the patient should lie on her back in a half-sitting posture; two fingers should be passed into the anterior fornix, while the other hand rests on the abdomen. To an experienced



With permission from Eden and Holland's "Manual of Obstetrics."

FIG. 80.—Hegar's Sign.

examiner this is a useful sign of pregnancy. External ballottement will be described under the signs of the second half of pregnancy, as generally it cannot be made out until then.

Progressive and steady increase in the size of the uterus in pregnancy is most characteristic. To ascertain this, two examinations should be made, say, at an interval of three to four weeks, to enable the examiner to appreciate its increase in height and in dimensions. This, combined with cessation of menstruation for a period of time corresponding to the size of the uterus, is a sign of great value.

PREGNANCY TESTS

Proof that the tenor of the maternal metabolism is disturbed from the earliest days of pregnancy is furnished by certain biochemical and biological tests as well as by age-long clinical experience. Many such tests have been devised, tried out and found unreliable. Only a few of them call even for mention.

Abderhalden's Serum Reaction, which was described in 1912, was based upon the theory that the serum of a pregnant woman, in contradistinction to that of a non-pregnant woman, contains ferments which can digest the fragments of chorionic epithelium that are known to be constantly invading the maternal organism by way of the bloodstream. The test is a reproduction *in vitro* of these conditions. It proves the correctness of Abderhalden's theory, but unfortunately positive results are not specific to the condition of pregnancy, and therefore the test, which is a complicated one to perform, has fallen completely out of use. Historically and scientifically, however, it is of much interest.

Sugar Tolerance Tests, of which there are several, are all based on the observation that glycosuria can be produced more easily in the pregnant than in the healthy non-pregnant woman. This is due to one or both of two factors : (1) a lowered kidney threshold for sugar, probably associated with the activity of the anterior pituitary lobe ; and (2) an impaired carbohydrate tolerance due to a diminished ability on the part of the liver to synthesise and retain glycogen, so that the ingestion of any considerable quantity of carbohydrate is followed by hyperglycæmia and glycosuria (p. 268).

The production of such an alimentary glycosuria was proposed as a test of pregnancy by Frank and Nothmann. The *phloridzin test* and the *adrenalin test* are merely modifications of it, in which the well-known influence of these substances in increasing the permeability of the kidney to sugar has been employed to intensify the results. Clinical experience has not found these tests to be sufficiently accurate for their purpose.

Complement-deviation tests, improved methods (Lüttge-Merz) of performing Abderhalden's reaction, and *blood-sedimentation tests* have all been described. All have their particular interests as illustrating the far-reaching and complex nature of the changes in the maternal blood, but none of them is wholly reliable. Our experience has led us to place rather more reliance on the Kapeller-Adler test as a rapid chemical method of determining the existence of pregnancy. It depends upon the recognition of histidine in the urine.

The urine is treated with a solution of bromine in acetic acid, and thereafter a mixture of ammonia and ammonium carbonate in solution is added. When heat is applied a coloration ranging from red to reddish-violet appears within two or three minutes, and shortly afterwards the fluid deposits brown-

black amorphous flakes of the dye. Alkaline urines must first be treated with potassium permanganate in sulphuric acid solution.

In cases of normal pregnancy almost 100 per cent. accuracy is claimed, whereas in 3 per cent. of non-pregnant women a positive reaction may also occur. Positive reactions have been obtained as early as one week after the first missed period. The test has also given positive results in cases of tubal pregnancy. The histidine excretion persists throughout a normal pregnancy but ceases a few days after delivery or abortion.

(*Journ. Obst. and Gyn., Brit. Emp., April 1941.*)

The outstanding exceptions to this general unreliability are the biological *hormone tests* known as the *Aschheim-Zondek* and the *Friedman tests*. In 1927 Aschheim proved the presence of anterior pituitary hormone in the urine of a woman who was five weeks pregnant. In the following year he and Zondek published the first report of their pregnancy test, and thereby gave a tremendous impetus to the study of the female sex hormones. Briefly the test depends upon the recognition of certain hormones (*prolans*) in the urine of the pregnant woman, which are almost, but not quite, identical with the gonadotropic hormones secreted by the anterior pituitary lobe. These prolans are believed to be elaborated (p. 63) by the chorionic epithelium in the growing placenta, so that the test is essentially *one for the presence in the body of living chorionic tissue*. Thus the test is positive not only in normal pregnancy but in a living tubal pregnancy, and remains positive for a varying time after the death of the ovum provided it is not cast out of the uterus (*e.g.* carneous mole). It is positive to a very excessive degree in hydatidiform mole and in chorionepithelioma owing to the exuberant growth of the chorionic epithelium in these conditions.

The patient's morning urine is first detoxicated and then injected thrice daily for two days, in doses increasing from 0.2 to 0.4 c.c., into five immature female mice, whose ovaries and uteri are still infantile.

If the patient is pregnant the hormones in the urine will produce an intensive growth and development in the ovaries of the mice, as shown by (1) follicular development, (2) hæmorrhage into some follicles and (3) formation of corpora lutea. These changes occur within ninety-six hours, when the mice are killed and examined.

The Aschheim-Zondek test is recognised as the most generally useful and reliable test of pregnancy, and in expert hands yields at least 98 per cent. of accurate results. Negative errors are occasionally met with in the earliest weeks, and in such cases the test should be repeated after the lapse of a fortnight.

The success of the above test produced numerous modifications and imitations of which Friedman's is the most important. In it a virgin doe rabbit which has been kept segregated from the male for at least four weeks is injected with 5 to 10 c.c. of the urine. Normally ovulation occurs in this species only some eighteen hours after copulation. Injection with urine from a pregnant woman produces

corpora lutea and corpora hæmorrhagica within twenty-four to thirty-six hours.

Probably the most certain method is to employ both the Aschheim-Zondek and the Friedman tests. The latter gives a rapid answer with a high probability of accuracy ; the former confirms (or very occasionally disputes) it two or three days later with a still higher degree of accuracy.

Hogben's test consists in the injection of the patient's urine into the female toad, *Xenopus lænis*. If the patient is pregnant, this results in the toad ovulating, and the eggs can be seen in the bottom of the vessel in which the animal is kept twenty-four hours later. The test promises to prove highly reliable.

Recently interesting observations have been made on the recovery from the urine of *sodium pregnandiol glucuronide* and on its quantitative estimation in terms of pregnandiol, which suggest that herein we have another hormonal test of the existence of pregnancy. Pregnandiol, either combined or free, is the form in which progesterone is excreted, and its presence indicates a functioning corpus luteum. Pregnandiol is found in the urine in the post-ovulatory phase of the menstrual cycle and in increasing quantities during pregnancy. The mean output at different stages of pregnancy has now been worked out, and its presence in an appropriate quantity in the urine of a woman who has missed a monthly period is strongly suggestive of early pregnancy. More prolonged trial of this method is required before its value as a pregnancy test can be stated, but there is evidence to suggest that the estimation of pregnandiol has the further value that low outputs, indicating a low level of corpus luteum function, may signify the danger of abortion (p. 334).

RADIOGRAPHIC EXAMINATION

This subject is considered in Chapter LX on Radiography. Here it is only necessary to state that by the sixteenth week the foetal skeleton is sufficiently ossified to be recognisable in favourable circumstances, and in higher and higher proportions as gestation advances. This method of examination may be helpful in the first half of pregnancy, in the differential diagnosis of hydatidiform mole, carneous mole, and some cases of tubal pregnancy from a normal pregnancy.

II. SIGNS OF PREGNANCY DURING THE SECOND PERIOD

From mid-term onwards the objective signs of pregnancy are more definite, and the diagnosis is correspondingly easier, although not free from possible errors. The methods of examination just considered must all be kept in mind and put in practice.

The patient should be questioned again as regards the date of her last menstruation. She should be asked if she has felt *quickening* or

“life.” By this is meant the perception by the mother of the movements of the *fœtus in utero*. These are generally first felt about mid-term, and are really dependent on the fact of the fundus uteri coming into close contact with the anterior abdominal wall, the nerves of which convey to the mother the sensation of the *foetal* movements. Consequently they are generally felt earlier in *multiparæ* than in *primigravidæ*, as in the former the uterus rises earlier out of the pelvis owing to the abdominal walls being more relaxed. Possibly, also, a *multipara* is able to recognise the movements earlier on account of her previous experience. The movements are often not felt by *primigravidæ* till the end of the twentieth week, while *multiparæ* may recognise them as early as the end of the sixteenth week. The first sensations are but slight and are often confused with movements of flatus in the intestine, especially by *primiparæ*. No weight must therefore be given to this subjective phenomenon so far as the diagnosis of pregnancy is concerned, though it sometimes serves as a useful corroborative check in determining how far the pregnancy has advanced. As pregnancy progresses these movements become stronger.

When the movements of the *fœtus* are recognised by the examiner, either on abdominal palpation or by bimanual examination, they are in themselves a certain sign of pregnancy; nothing can exactly simulate them. Not only may they be felt, they may also be seen, especially in women with thin abdominal walls.

PALPATION

PALPATION in the second half of pregnancy gives most valuable information as to the height, form, situation and consistence of the uterus, besides enabling one to determine the presentation and position of the *fœtus* in the later months (p. 385). The uterus generally tends to lie more to the right side and is rotated to the right (80 per cent.).

The height of the uterus may be measured with calipers from the upper border of the symphysis pubis—the patient lying in the dorsal position, so that the uterus falls back against the spinal column. The fundus rises in the abdomen at the rate of 1·6 inches (4 cm.) a month during pregnancy. The measurements are subject, however, to considerable variations. They are affected by the amount of liquor amnii, size and position of *fœtus*, and formation of the pelvis, so that the figures in the following table must be regarded as only approximately correct :—

At 4 calendar months the fundus uteri is				5·0 inches (12·5 cm.) above the pubes.			
„ 5	„	„	„	6·0	„ (15 cm.)	„	„
„ 6	„	„	„	8·0	„ (20 cm.)	„	„
„ 7	„	„	„	9·6	„ (24 cm.)	„	„
„ 8	„	„	„	11·2	„ (28 cm.)	„	„
„ 9	„	„	„	12·8	„ (32 cm.)	„	„

During the last two weeks of pregnancy the uterus sinks 2 or 3 cm.

down from the xiphoid cartilage. This is called *lightening*, and is more marked in primigravidæ in whom it coincides with the "engagement" of the head (p. 376). It is associated with an increased feeling of comfort in breathing, but also a greater sense of pressure in the pelvis and greater difficulty in locomotion.

The umbilicus is not a fixed point, and should not be used as a landmark for accurate measurements. Usually at the fifth calendar month the fundus is just below the level of the umbilicus, and at the sixth month about one finger-breadth above it. The circumference of the abdomen (at term) at the level of the umbilicus in a normal pregnancy measures about 36·8 inches (92 cm.). Any measurement over 40 inches may be regarded as abnormal.

Abdominal palpation for the purpose of determining the "presentation" and "position" of the child is considered later (p. 385).

INTERMITTENT UTERINE CONTRACTIONS, or the painless contractions of pregnancy (*Brazton Hicks' sign*), are characteristic of pregnancy, and when recognised are an almost certain sign of its existence. They may be felt during the bimanual examination, as already mentioned, but much more directly and distinctly when the uterus has risen into the abdomen. Sometimes they may even be visible on inspection. The uterus hardens and its outline becomes clear and distinct for a few seconds. It then relaxes and becomes soft again and its outline becomes indistinct. These contractions recur at intervals of five to ten minutes as a rule, and may be stimulated by a cold hand, by long or repeated palpation or even by the movements of standing up or lying down. They are very occasionally felt in hæmatometra and very rarely in soft fibroids of the uterus, where there is an excess of muscular tissue. In the latter case, the contractions are usually limited to localised areas.

These painless contractions no doubt assist in (1) determining the gradual accommodation of the foetus to the uterine cavity; (2) the carrying on of the placental circulation; and (3) later the formation of the lower uterine segment and the engagement of the presenting part.

The *recognition of active foetal movements* by palpation, as already mentioned, and the perception of the foetal parts, are each, of course, absolutely diagnostic of pregnancy. For the former, very light palpation should be practised; for the latter, the palpation must be firmer and more methodical. The method of palpating the foetal parts will be described fully under the different presentations. It is sufficient to state here that the head, the back, the breech and the limbs should be carefully sought for and recognised. The foetal parts may be recognised at the sixth month, more readily from the seventh month onwards. The normal pregnant uterus is, as a rule, painless on pressure, but very often slight tenderness is complained of when the head is pressed upon, and this is a useful point to remember (*vide Breech Presentation*, p. 459).

PERCUSSION.—The pregnant uterus gives a dull percussion note as there is never any intestine in front of it.

INTERNAL BALLOTTEMENT has already been described and can usually be elicited up to about the seventh month. In multiparæ it can sometimes be recognised at term, more especially in cases of hydramnios.

EXTERNAL BALLOTTEMENT is not usually so satisfactory or conclusive as the internal method. It is best felt about the fifth or sixth month, when the uterus is still spherical. The two hands are placed on opposite sides of the uterus, the patient lying on her side. The foetus can be "tossed" between the two hands, and when the hands remain quiescent it is felt to fall back on the lower hand with a distinct tap. This sign of pregnancy may be made out even if the child is dead.

In breech cases the foetal head at the fundus can usually be "ballotted" slightly from side to side—a diagnostic point of value in such presentations (p. 459).

A movable tumour floating in ascitic fluid—*e.g.* carcinoma of bowel or an ovarian fibroma—may give a somewhat similar sensation, and the tumour may bear some resemblance to a foetus in shape.

AUSCULTATION

This method of examination is of the greatest possible value in the diagnosis of pregnancy during the second period. Two sounds may be distinguished: (1) the maternal *souffle*, and (2) the foetal heart-beat.

MATERNAL SOUFFLE.—The *uterine souffle*, or bruit, may be heard from the end of the fourth month onwards on both sides of the uterus. It is synchronous with the mother's pulse, systolic in rhythm and of a soft blowing character. It was at one time erroneously called the "placental souffle," under the impression that it had its origin in the placenta. As, however, it can still be heard after the placenta has been expelled it is clearly independent of its presence. It has its origin in the uterine vessels, which become widened out in the uterine wall. During contraction of the uterus or deep pressure with the stethoscope the souffle becomes louder and higher in pitch. It is sometimes also heard in soft vascular fibroid tumours of the uterus (p. 948). It is therefore not of *absolute* diagnostic significance, though in association with other signs it may be of great value.

FOETAL SOUNDS.—The *foetal heart-sounds* can be heard from the end of the fifth month onwards, nearly a month later than the uterine souffle, and when distinctly recognised are, of course, in themselves an absolute sign of pregnancy. They also prove that the foetus is alive. The heart-sounds are characterised by their recurring in groups of two in quick succession, each group of two being separated by a very short silence. The first sound corresponds to the systole and is more feeble than the second, which is produced by the diastole. The absence

of the long silence gives to the foetal heart-sounds a peculiar rhythm which has been called the foetal rhythm, somewhat resembling the muffled ticking of a watch.

The rate varies between 120 and 150 to the minute, being usually slower in large children than in small. The most common rates are from 130 to 140. When they sink persistently below 100 or are increased to 160 this is evidence of the child's life being in danger owing to some circulatory disturbance.

Uterine contractions modify the foetal heart-beats. At first they are accelerated and subsequently slowed down, while during the height of a uterine contraction they may no longer be heard. Deficiency of oxygen, pressure on the cord and interference with the placental

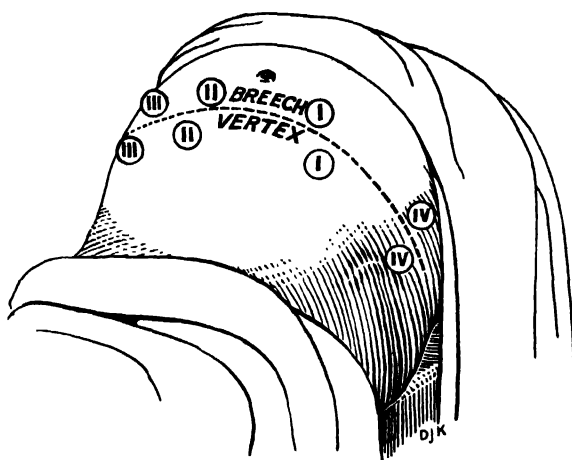


FIG. 81.—Areas of Maximum Intensity of Foetal Heart-sounds. Below dotted line in cranial presentations; above dotted line in breech presentations.

circulation, from whatever cause, slow the beats, hence the importance of auscultation from time to time during prolonged labours.

At the fifth and sixth months of pregnancy the foetal heart-sounds can be heard in the middle line midway between the pubes and umbilicus; at the seventh and eighth months, usually in a line drawn from the umbilicus to the left or right anterior superior spine. During the ninth month they are heard with maximum intensity at varying points corresponding to the different presentations and positions of the foetus. The point of maximum intensity corresponds roughly with the scapula of the anterior shoulder.

In auscultating for the foetal heart the examiner should have the abdomen thoroughly exposed, have absolute quietness in the room and make sure that he does not confuse the foetal pulse with the mother's pulse or even with his own. The best instrument is a wide-mouthed aluminium or wooden stethoscope. Inability to hear the foetal heart does not necessarily mean that pregnancy does not exist or that

the child is not alive ; but after hearing it once, and repeatedly failing to do so on subsequent examinations, a suspicion of foetal death may naturally arise.

In dorso-posterior positions of the child, in hydramnios, and when the abdominal walls are very thick, the heart-sounds may be inaudible even though the child is alive. While auscultating the pregnant uterus the movements of the foetus are frequently observed either in the form of direct impacts or of sounds like coarse friction or rubbing.

When foetal heart-sounds are distinctly heard with maximum intensity in different areas, and especially if of different rates of frequency, twin pregnancy may be diagnosed (p. 495).

THE FUNIC SOUFFLE, synchronous with the foetal heart-sounds, may be heard towards the end of pregnancy in some 10 per cent. of cases. It is a soft blowing murmur, due to some obstruction in the vessels of the cord such as may be caused by true knots, or even by the pressure of the stethoscope if the cord be lying between it and the back of the foetus. If it persists during labour the prognosis for the child is bad, especially when the heart-beats become slower at the same time.

RADIOGRAPHY

In the second half of pregnancy this method of examination is now widely employed for the determination of the presentation of the foetus, as well as for the recognition of plural pregnancy, malformations of the foetus, especially anencephalus, hydrocephalus, etc., in association with hydramnios, and intrauterine death of the foetus. Further, by the use of special methods, the exact shape and size of the maternal pelvis can be learned and the size of the foetal head accurately estimated in relation to the pelvic dimensions. Details in regard to methods will be found in Chapter LX on Radiography.

RÉSUMÉ OF SIGNS OF PREGNANCY

Until recent years pregnancy could be diagnosed with *certainty* only when one or more of the following signs were present : hearing the foetal heart, palpation of foetal parts, and the feeling of active movements of the foetus. To these could be added the recognition by the experienced examiner of ballottement or passive foetal movement, and the waves of rhythmical painless uterine contractions involving the whole extent of the uterine tumour. To-day the Aschheim-Zondek test in the early days (twelve to fifteen days onwards) and X-rays by the fourth month may be usefully employed, and by means of them pregnancy can be determined with certainty in cases of doubt.

The presence of several of the *probable* signs of pregnancy may justify the examiner in giving an *opinion* as to the existence of pregnancy before mid-term if he feels in a position to do so. But there are

circumstances (especially legal ones) in which it is wiser to withhold an opinion till a certain sign has declared itself, even though he is morally sure of his diagnosis.

The presence of merely presumptive signs, and especially when only subjective evidence is forthcoming, is not sufficient for the expression of an opinion. These evidences may and often do afford ground for suspecting the existence of pregnancy, but no definite opinion should be expressed in the absence of adequate physical signs or biological or X-ray tests.

Married women will often be found to have formed their own diagnoses from their symptoms before they seek medical advice, but the practitioner must be careful not to acquiesce in all such purely symptomatic diagnoses until he has made a careful physical examination. Many grievous mistakes and disappointments have occurred from neglecting this precaution.

TABULAR STATEMENT OF SIGNS AND SYMPTOMS OF PREGNANCY ARRANGED CHRONOLOGICALLY

Amenorrhœa is normally present during the whole of pregnancy. Menstruation is possible for the first three months but is always diminished in quantity in such circumstances. The Aschheim-Zondek reaction *may* be found positive from as early as the twelfth day.

End of First Month.

Possible morning sickness.
Slight enlargement and discomfort in mammae.
Bladder irritability.

End of Second Month.

Morning sickness and digestive disturbances.
Pigmentation of areolæ in primigravidæ, especially in brunettes.
Montgomery's tubercles.
Vaginal pulsation and possibly Hegar's sign.
Bladder irritability.
Fundus uteri just below upper border of symphysis pubis.

End of Third Month. In addition to above there are :

Morning sickness diminishing.
Slight mammary secretion.
Softening of cervix.
Discoloration of cervix and vagina.
Intermittent contractions of uterus and apparent shortening of cervix.
Fundus about 1 inch (2.5 cm.) above pubes.

End of Fourth Month.

Breast changes accentuated.
Quickening may be felt in multiparæ.
Uterine souffle.
Internal ballotement.
Increasing softening and discoloration of cervix and vagina.
Intermittent uterine contractions.
Fundus, above pubes, half-way to umbilicus.
X-ray photographs from this time onwards.

End of Fifth Month.

Other signs as in fourth month.
Fœtal heart-sounds may be heard from this time onwards.
Fœtal movements felt by examiner.
Secondary areola.
Fundus just below umbilicus.

End of Sixth Month.

Perception of fœtal parts.
Striæ gravidarum and linea nigra.
Umbilicus flush with skin surface.
Fundus a little above umbilicus.
Other signs as in fifth month.

End of Seventh Month.

Fundus about three finger-breadths above umbilicus.
Fœtal heart, parts, movements, uterine contractions, well marked.
Striæ in abdomen and breasts.

End of Eighth Month.

Fundus about two finger-breadths below xiphisternum
Other signs as in seventh month.

Ninth Month.

Fundus reaches xiphisternum in latter half of the month, sinking a couple of finger-breadths during the last fortnight ("lightening").
Bladder irritability.
Eversion of umbilicus.
Fœtal head becomes fixed in primigravidæ.
Cervix becomes taken up (real shortening).

THE DIFFERENTIAL DIAGNOSIS OF PREGNANCY

This is one of the questions which is intimately associated with gynæcology. Both departments are on common ground, and here, if anywhere, it is of the highest importance that the obstetrician and gynæcologist should be combined in one and the same person. A careful consideration of all the symptoms and signs of pregnancy, which constitute the general syndrome of the approximate period of gestation under consideration or suspicion, should obviate most of the mistakes which from time to time are made. Obscurity can be cleared up by an Aschheim-Zondek or Friedman test even in the early weeks, and from the fourth month onward with increasing certainty by radiography. But where for any reason recourse cannot be had to these diagnostic aids the best procedure is to make a careful examination under an anæsthetic, and, should doubt thereafter persist, to repeat it two or three weeks later, by which time more definite signs will have developed.

The cases in which difficulty is most commonly experienced are in the first half of pregnancy, when the positive signs have not yet manifested themselves.

Early pregnancy may be mistaken for a subinvolted uterus, a small interstitial or submucous fibroid of the uterus, or a hæmatometra. Each of these conditions may present physical signs somewhat similar to a two or three months' pregnancy. Hæmatometra is, of course, also associated with amenorrhœa, and is felt to be soft and globular on examination. It is usually tender on palpation, in contrast with the painlessness of a normal pregnancy.

The table on p. 178 gives the main points of difference between a six months' pregnancy, an ovarian cyst and a fibroid tumour of the uterus of approximately the same size.

Pregnancy may, of course, be associated with an ovarian tumour, and a woman with a fibroid tumour may become pregnant. In the latter case the fibroid may undergo rapid enlargement.

Difficulty may sometimes be experienced in diagnosing a pregnancy where a dead fœtus is retained *in utero*.

A distended bladder must always be remembered as a possible cause of abdominal swelling. When the bladder is distended to the size of a four or five months' pregnancy, it is tender on palpation and is usually associated with the "incontinence of retention." This is frequently associated with incarceration of the gravid retroverted uterus (p. 287). The passage of a catheter is, of course, the first step indicated.

Pseudocyesis, Phantom Tumour, or Spurious Pregnancy.—These terms are applied to a curious condition occasionally met with about the time of the menopause, in which a woman believes herself to be pregnant and manifests several of the symptoms of pregnancy, but yet no pregnancy exists. She is generally strongly desirous of having a

Six Months' Pregnancy	Ovarian Cystic Tumour	Uterine Fibroid
1. Amenorrhœa for 6 months.	1. Usually no amenorrhœa.	1. Menorrhagia in sub-mucous and interstitial: ordinary menstruation in subperitoneal.
2. Aschheim - Zondek test positive.	2. A.-Z. negative.	2. A.-Z. negative.
3. History of morning sickness in early months.	3. No morning sickness.	3. No morning sickness.
4. Quickening at 4½ months.	4. No quickening.	4. No quickening.
5. Swelling of abdomen up to about height of umbilicus, often with right lateral obliquity.	5. Swelling of abdomen, either mesial or to right or left side.	5. Swelling less rounded as a rule than a pregnancy or ovarian cyst, with a more abrupt contour at upper margin.
6. Fresh striæ on lateral and lower abdominal areas.	6. No fresh striæ as a rule, but there may be old ones.	6. No fresh striæ, as growth is generally slow.
7. Palpation—the tumour is somewhat soft, but alters in consistence from intermittent contractions. Dull on percussion. Fluid wave in hydramnios.	7. Cystic swelling recognised. No alteration in consistence from contraction and relaxation. Dull on percussion, with possible fluid wave depending on nature of contents.	7. Tumour usually hard and irregular in outline unless in submucous or soft, cystic or oedematous fibroids. No appreciable alteration of consistence.
8. Fœtal parts can be felt.	8. No fœtal parts. (Pregnancy may coexist with a cystoma.)	8. No fœtal parts, though some irregular projections may simulate them. (Pregnancy may coexist with a fibroid.)
9. Fœtal heart-sounds and uterine souffle.	9. No fœtal heart-sounds and very rarely a souffle in some broad ligament cysts.	9. No fœtal heart-sounds. Souffle very occasionally heard.
10. Characteristic signs in mammæ: both areolæ present.	10. No general mammary signs: sometimes a little secretion.	10. No mammary signs.
11. Characteristic changes in vaginal and vulvar mucous membrane.	11. No change.	11. No change.
12. Ballottement may be elicited.	12. No ballottement.	12. No ballottement.
13. Comparatively rapid growth and the swelling is continuous with the cervix.	13. Tumour may have been present for more than a year. Empty uterus can usually be made out separate from tumour.	13. Tumour is usually of slow growth: uterus not separate from the tumour: uterine cavity usually increased in length as measured by the sound.
14. X-ray photograph—fœtal skeleton.	14. Shadows in case of dermoid.	14. Ill-defined shadow.

child, has possibly had previous false expectations and disappointments, and her mind is obsessed with the idea of achieving her desire.

The patient may have complete or partial amenorrhœa, she develops morning sickness, her breasts and abdomen increase in size from adiposity, and she imagines she feels foetal movements, probably the results of flatulence. Her abdomen may subsequently become greatly distended, she has to let out her clothes, and her figure has superficially some appearance of pregnancy. On closer examination the abdomen is found to be uniformly distended as if blown out with gas ; it is tympanitic on percussion and no solid tumour is to be felt. On bimanual examination the uterus is found to be not enlarged. It is sometimes difficult to persuade the patient and her friends that there is no pregnancy, impressed as they are with the prominence of the abdomen. If the patient is anæsthetised the tumour disappears and the abdomen becomes quite flat, the swelling reappearing when she comes out of the anæsthetic. It may sometimes be necessary to demonstrate this phenomenon to the husband or a relative in order to overcome their incredulity.

The cause of this remarkable abdominal distension is a hysterical contraction of the diaphragm pressing down the abdominal contents, associated with a certain amount of flatulent distension and fixation of the abdominal muscles. The anæsthetic relaxes the muscular spasm and the abdomen under its influence becomes flat and soft. It is highly probable that disturbed hormonal activity (corpus luteum, anterior lobe of pituitary body), occurring in a woman whose mind is obsessed by her craving for maternity, is responsible for the condition. It appears to have some analogy to the pseudopregnancy which occurs quite commonly in lower animals as a result of sterile mating (p. 53).

The importance of the physical examination need not be elaborated, nor the danger of trusting to subjective signs in coming to a diagnosis.

SIGNS OF FORMER PREGNANCY

These are to be looked for, but are not always obvious. A woman may have had a very small child, a premature child or an abortion without leaving any recognisable signs at all.

On the other hand, indications of previous delivery at or near full time are generally to be found as follows :—

1. The *skin of the abdomen* is usually more or less relaxed and easily drawn up into folds. There are generally old *striæ gravidarum*, white and silvery in appearance—the *lineæ albicantes*. *Striæ*, however, are absent in a considerable number of cases, either because the abdomen has not been greatly distended or because the woman's skin has specially elastic properties, and stretches easily. *Striæ* may also be caused apart from pregnancy by other conditions which rapidly

stretch the abdomen—*e.g.* adiposity, ascites or ovarian cysts. In brunettes the remains of former pigmentation may persist.

2. The *mammæ* are more flabby as a rule, and may be pendulous, with old striæ and prominent nipples. Remains of former pigmentation may be visible in dark women, but may be absent in blondes. In women who have not lactated the breasts may not be much altered in appearance.

3. While the *uterus* never quite regains its former size after the first pregnancy, this cannot be distinguished clinically from slight enlargement due to some pathological condition. The cervix is enlarged and the os uteri, in place of being a small circular or oval opening, is practically always converted into a transverse slit (p. 20), sometimes with lacerations, very often deeper on the left side. Previous operation on the cervix may, however, modify the shape of the os considerably, and this should always be inquired into.

4. The *vagina* is smooth and roomy, and the rugæ, especially on the posterior wall, are largely gone. There may be cicatrices in the vagina from previous laceration.

5. The *vulva*. The remains of the hymen are represented by warty prominences—the *carunculæ myrtiformes*.

The fourchette is always torn during labour at term and is either absent or cicatrised.

The fossa navicularis is flattened out and has practically disappeared.

The ostium vaginæ is relaxed and often a perineal cicatrix may be visible.

CHAPTER IX

DURATION OF PREGNANCY—POST-MATURITY—DATE OF DELIVERY—CAUSE OF LABOUR

EXPERIENCE proves that the average interval between the beginning of the last menstrual period before impregnation and the birth of the child—the *menstruation-delivery interval*—is 280 days. There is no dubiety about this point, which is capable of easy verification; but the matter is quite different when we consider the *conception-delivery interval*, because we have as yet no means of knowing the exact date of the fertilisation of the ovum.

Formerly it was believed that the conception-delivery interval—*i.e.* the duration of pregnancy—was 273 days. This view was based on the assumption that ovulation occurred immediately after menstruation, and on this assumption the 280 days of the menstruation-delivery interval were allotted as follows: 4 days for the menstrual period, 3 days subsequently during which fertile intercourse presumably took place and 273 days for the actual duration of pregnancy. One of the most serious stumbling-blocks to the acceptance of this view was that it was in direct antagonism to the well-known exceptional fertility of orthodox Jewesses, amongst whom coitus is not permitted for a week after the end of the menstrual period. More recently we have learned that ovulation occurs most frequently between the 12th and 17th days after the beginning of the menstrual flow—an observation which upsets the old calculation, but incidentally explains the fertility of the orthodox Jewess.

Two other important biological observations help to narrow the time within which conception is most likely to occur. One is the observation that the spermatozoa probably do not retain their fertilising power for more than a few hours (p. 817). Several observers have noted the presence of motile spermatozoa in Fallopian tubes removed as late as 20 days after the last admitted coitus, but mere motility does not prove that these spermatozoa were still capable of the vastly greater output of energy required to fertilise an ovum; and biological evidence indicates that in all animals with scrotal testes the spermatozoa lose their fertilising power within the period stated owing to the effect of the higher intra-abdominal temperature.

Biological evidence also indicates that the ovum is susceptible of fertilisation for only a few hours after its liberation from the Graafian follicle. If these observations are correct, then conception can occur

only when potent spermatozoa are in the immediate neighbourhood of the ovum within that brief period after ovulation.

Modern scientific evidence thus suggests that the *actual duration of pregnancy* — the conception-delivery interval — is probably nearer 265 than 273 days, but there are possibly individual variations amongst women just as there are amongst mares and cows and other animals in whom the exact dates of coitus are actually known to breeders.

On the basis of the observations just referred to Knaus maintains that coitus can be fertile only if it occurs during a period covering 3 days before the date of ovulation and 1 day after it. He states that where the exact time of ovulation can be calculated from accurate knowledge of the dates of menstrual periods extending over several months in women whose periods are "regular," this information affords a physiological method of contraception, any time outside the limit stated being a *safe period*. Knaus brings forward a considerable body of evidence to support his claim, and in regard to a woman who menstruates with complete regularity it may perhaps be allowed. But the accumulation of accurate evidence all points to the view that comparatively few women menstruate with anything like complete regularity. Gunn, Jenkin and Gunn recently collected accurate data from 770 women and found (*inter alia*) that in 84 per cent. there was a difference of at least 6 days between the shortest and the longest inter-menstrual intervals. "The term 'regular,'" they state, "has no precise meaning in connection with menstruation." It may be assumed that the occurrence of ovulation is subject to the same variations as menstruation, and some women may possibly ovulate more than once a month. Lastly, the experience of most obstetricians seems to indicate that in some women conception can follow coitus at practically any period of the inter-menstrual interval. Knaus's "safe period" is therefore safe for only a very limited number of patients.

That pregnancy, followed by the birth of a fully developed child, may be prolonged or abbreviated is an observed fact. The usual explanation is a miscalculation as to dates; in other cases it may be due to individual variation. It has been suggested that the duration of pregnancy coincides with the length of ten menstrual cycles, but the evidence is inconclusive, and calculations of the date of confinement on such a basis are not more accurate than those reached by the ordinary method. Fully developed children have been recorded as being born after gestations as short as 240 days and as long as 313, 320 and even 331 days from the commencement of the last period. The point has obvious medico-legal importance in cases where the legitimacy of a child born after the death or temporary absence of its reputed father is questioned. In this country and in the United States no fixed period of utero-gestation is laid down by law; each case is considered on its own merits. A recent judgment in the Scottish Courts recognised a gestation period of 306 days. The period of 331 days allowed in the

case of *Gaskell v. Gaskell* by the late Lord Birkenhead in the English Courts was based upon the fact that refusal to recognise this period would have placed the stigma of adultery upon the woman, and as there was no scintilla of evidence to support it the Court refused to draw such a deduction. Genuine cases of prolonged gestation are almost invariably associated with signs of post-maturity of the foetus.

POST-MATURITY

Abnormally prolonged utero-gestation is undesirable in the interests of the child, which is generally above the average in length and weight and in the degree of ossification of the cranial bones. From a medico-legal point of view undue length is more important than weight. Obstetrical difficulties due to disproportion are therefore not uncommon. There is some risk of the child dying *in utero* before birth, probably as a result of advanced "senile" changes in the placenta. Where there is good reason to think that a pregnancy has definitely exceeded the normal duration, the induction of labour should be seriously considered.

CALCULATION OF THE PROBABLE DATE OF DELIVERY

As it is impossible to tell the actual day when fertilisation of the ovum occurs, calculation of the date of delivery must be made from more indefinite data, which, fortunately, are sufficiently accurate for most practical purposes.

The best method of estimating this date is to take the first day of the *last menstrual period*, add 7 days, and then either count 9 months forward or 3 months backwards. This gives a menstruation-delivery period of 280 days, as already explained. For example, if a woman gives the first day of her last menstrual period as the 12th July, add 7 days and count forwards 9 months or backwards 3 months, which will give the approximate date of her confinement as the 19th April.

It is said that this method of calculation gives a 5 per cent. chance of delivery actually occurring on the 19th April, a 25 per cent. chance of its taking place between the 17th and 21st April, and a 48 per cent. chance of its occurring between the 14th and 24th April.

The *first date of quickening* in experienced pluriparae may be used as a check to the calculation based on the cessation of menstruation, but in a primigravida it is not always reliable as she may fail to recognise the significance of the early movements. As a rule quickening occurs from the 18th to the 20th week of pregnancy.

As explained in the preceding chapter the estimation of the *size of the uterus or of the foetus* may sometimes be used as a means to try to assess the period of gestation reached, and so to calculate the probable

date of delivery. Nearer term, the descent of the head in a primigravida generally indicates that labour will ensue in about a fortnight.

Zangemeister has noted that in the last 3 or 4 days before the onset of labour there is a definite *drop in the patient's weight*, which up to that time has been steadily increasing; and he maintains that this drop is so uniform in its occurrence that it may be used as a practical indication of the imminence of labour.

CAUSE OF LABOUR

The reason why the uterus should cast off its contents at the end of 40 weeks of gestation is a problem which has exercised obstetricians throughout the ages. A great many theories have been advanced from time to time to explain it, but recently these have all been eclipsed by our scientific knowledge of the hormonal control of the uterus during pregnancy. Before dealing with this subject it is only right to mention some of the more important of the older theories, for those which were based on clinical observation must command our fullest respect and attention, and indeed contain considerable elements of truth which are now made understandable by the newer knowledge.

It had long been observed that the intermittent contractions of the uterus become stronger and more frequent as pregnancy goes on, and that the uterus becomes more irritable or susceptible to stimulus. Thus the nearer a pregnancy is to term the easier it is to induce labour artificially. At or about the 40th week this increasing irritability and activity of the uterus might be considered to culminate in the onset of labour.

The irritability or susceptibility of the uterus is greatest at the menstrual epochs, as is evidenced by the increased tendency for abortions to occur at these times. Some have postulated a tendency on the part of the uterus to cast off its lining membrane at these epochs, and this in the case of a pregnant uterus would lead to the onset of labour. This view is to be regarded as supplementary to the previous one.

Again, it has been thought that the enlargement of the uterus may be a determining factor, for cases in which it is prematurely enlarged—*e.g.* multiple pregnancies, hydramnios, etc.—usually terminate prematurely.

An important view depends upon the fact that children born at the 40th week have the best chance of survival. Prematurity and post-maturity both involve serious dangers to the foetus. Natural selection would then tend to perpetuate the characteristic of a 40-weeks gestation.

With the advent of knowledge of the hormonal control of the reproductive organs it was thought that the real reason of the onset of labour had been found. We learnt that the oestrin content of the

blood increased throughout pregnancy, and we believed that with the retrogression of the corpus luteum from the fourth month its antagonising influence to the œstrin stimulation of uterine muscular activity gradually waned. So we assumed that with this gradual alteration in the balance of these hormones a point was reached after forty weeks when the uterus was so sensitised to the action of the posterior pituitary hormone as to go into the powerful contractions of labour.

Unfortunately further knowledge has convinced us that the problem is not so simple. The theory, just stated, rested upon three assumptions, namely (1) the withdrawal of progesterone, (2) the influence of œstrin on the myometrium, and (3) the stimulation of the myometrium by posterior pituitary hormone (oxytocin).

In regard to the first we now know that in women progesterone secretion is not withdrawn but increases parallel with œstrin as pregnancy advances, and at the time of labour (and sometimes also of abortion) is being excreted in large amounts as pregnandiol in the urine.

In regard to the second there are three points which cast doubt upon it: (1) that the pattern of œstrin-induced motility differs considerably from that of the parturient uterus; (2) even in experimental animals œstrin administered on the eve of parturition is found to hinder rather than to expedite labour; (3) its therapeutic application in the human subject has been successful only in cases of missed abortion.

In regard to the third, it has now been shown that labour takes place normally in animals from which the posterior lobe of the pituitary has been removed. Moreover, the contractions of the uterus in labour differ in some respects from those induced by the oxytocic factor in the posterior pituitary secretion.

On the positive side there is a rhythmic decline in hormone values of both œstrin and pregnandiol immediately preceding normal labour, which suggests the intrusion of an extraneous factor, but the associated values are only relatively, not absolutely, low. There is some evidence also that the blood of parturient women contains an oxytocic substance not of pituitary origin (? placental) which the blood of non-pregnant women lacks.

The high degree of co-ordination which the uterus shows in parturition is unaccounted for by the hormonal theory, and only in a superficial sense may it be supposed that hormones are the governing influence of this elaborate physiological process. "There is no known single cause for the onset of labour," says Reynolds in his well-known monograph on the Physiology of the Uterus. "Rather it now seems that parturition begins as a result of the gradual accelerating convergence of a number of factors—structural, humoral, nervous, nutritional and circulatory—which at a time characteristic for each species, and adapted to morphological conditions present in each, are so associated that they lead to evacuation by the uterus of its contents."

CHAPTER X

ANTENATAL CARE OR THE MANAGEMENT OF PREGNANCY—ANTENATAL CENTRE OR CLINIC

THE object of modern obstetrics is to secure healthy mothers and healthy babies—to guide pregnant women safely through their pregnancies, to deliver them of healthy children with the minimum of damage and to return them to their ordinary avocations in good health and fit for the bearing of other healthy children in due course. This involves (*a*) the medical supervision of every expectant mother throughout her pregnancy, and (*b*) the making of such obstetrical examinations as may be necessary to foresee dangers likely to arise at the time of labour, so that being foreseen they may be dealt with under the most favourable circumstances possible. This part of the obstetrician's programme is designated *antenatal care*.

The medical supervision is necessary, because even in the perfectly healthy woman pregnancy puts the strain of increased functional demands upon practically every organ, and the response or adaptation of the various organs to the new conditions is not always complete. Where disease or congenital inability to respond to the increased demands exists in any organ, watchful and continuous medical care is particularly necessary.

The care of the pregnant woman should be regarded not merely from this preventive aspect but also from a more constructive standpoint. By this is meant that the opportunity should be seized to inculcate some knowledge of mothercraft and of simple hygiene—both essentially preventive, but more constructively so than the mere endeavour to discover pathological conditions and obstetrical abnormalities. Indeed this constructive aspect of antenatal care holds out the brightest prospects of ultimately reducing the national cost of maternity, as estimated in terms of maternal and infantile mortality and morbidity.

It should be explained to the patient that this supervision is a precautionary measure. Otherwise she may tend to become unduly anxious about her condition.

The full significance of what follows will be realised if read in conjunction with Chapter VII, devoted to the Physiology of Pregnancy.

Diet.—The diet of the pregnant woman assumes special importance when we realise that she has to supply not merely the needs of her own body under conditions of strain but also the mineral and other requirements for the upbuilding of the fœtus. This is not such a

formidable proposition as it looks, and *a healthy woman on an ordinary good mixed diet has no need to take any additional food*. Amongst the poorer classes, and particularly in this era of tinned and preserved foods, the matter is different. Amongst such the principal care should be devoted more to the nature of the food than to its quantity, which is generally, although by no means always, sufficient.

Apart from nitrogenous substances and carbohydrates the principal foetal requirements are for calcium, iron and phosphorus. The foetus has to form its own blood and its own hæmoglobin, but it can only do so from the supplies of iron in its mother's blood and tissues. Furthermore, it has to store iron in its liver against the period of lactation, when it is being fed on a substance (mother's milk) poor in iron. It requires calcium and phosphorus for the formation of its bones; iodine; and vitamins (*vide* p. 145).

If these substances are present in adequate quantity in the mother's diet, all is well; but if not both the mother and the foetus (in that order) suffer from the deficiency. So far as calcium and phosphorus are concerned such deficiency shows itself in the child in a congenital tendency to rickets; and in the mother in dental caries, possibly in uterine inertia and postpartum hæmorrhage at labour, and in extreme cases in osteomalacia.

The foetus is rarely born deficient in iron, for it stores this in the liver, as stated (p. 144). But the mother very frequently suffers from anæmia during pregnancy if her diet is not sufficiently rich in iron. Achlorhydria may be a factor also in such cases, preventing the complete absorption of such iron as the diet does contain.

The direct results of vitamin deficiency during pregnancy are not often seen in this country, unless we subscribe to the recent view that the toxæmias of pregnancy are due to such deficiency. Elsewhere the most direct example is the prevalence of beri-beri in pregnant women in Eastern countries where the diet (polished rice) is notoriously deficient in vitamin B. There is, however, evidence to indicate the value of vitamin A as an anti-infective agent; of vitamin D as an antirachitic agent and an essential aid in the absorption of calcium and phosphorus; of vitamin C as an antiscorbutic; while vitamin E is believed to have some influence in maintaining early pregnancy. It is stated to act in a manner similar to progestin in antagonising the effect of oestrogenic hormones and so maintaining the necessary desensitisation of the uterus in the early months (pp. 64, 154).

To meet all these requirements an adequate diet for a pregnant woman should contain the following:—

Milk, including junket, cheese and butter—rich in calcium and phosphorus and vitamins A and D. At least 2 pints of milk should be taken daily.

Meat and eggs, for the provision of proteid. Liver, kidneys, lean meat and eggs are all relatively rich in iron.

Green vegetables such as cabbage, lettuce, spinach and peas ; also tomatoes, carrots and potatoes. These may well be taken twice daily as they provide vitamins B, C and E as well as iron. Fresh fruits—an apple or an orange or other seasonable fruit daily ; these are rich in vitamin C.

Sea fish, two or three times a week at least, for the iodine they contain.

Where there is any doubt as to the vitamin adequacy of a diet it should be supplemented by cod or halibut liver oil. The roughage necessary for bowel stimulation should be obtained by the addition of brown or whole-meal bread, oatmeal porridge, honey, marmalade and the vegetables and fruits mentioned.

The fluid content of the diet is a matter of great importance, as constipation is a very prevalent complaint in pregnancy. Water should be drunk before breakfast and between meals—at least 2 pints daily—either plain or flavoured with orange or lemon juice and sugar. Tea and coffee should be taken sparingly and alcohol either not at all or in the strictest moderation.

Constipation is almost the rule in pregnancy. Possibly the desensitising influence exercised upon unstriated muscle by the progesterone hormone of the corpus luteum may be a factor in this ; but pressure and diminished physical exercise also play a part in its production. It should be avoided as far as possible, because not only does it increase pelvic congestion but it may be an element in predisposing to toxæmic symptoms.

As far as possible it should be treated by diet—an adequate quantity of fluids and of roughage—and by exercise ; but most patients require drugs as well. On general principles potent griping purgatives should be avoided as they may possibly set up uterine contractions. If the patient is accustomed to any one laxative, its use may be continued. Otherwise recourse should be had to paraffin preparations, to cascara, senna, compound liquorice powder *et hoc genus omne*.

Outdoor Exercise in moderation is most essential, and no form of it is better than walking. In regard to dancing, games and the more violent forms of exercise, much depends upon what the patient is accustomed to. A woman who is accustomed to ride several times a week, for example, need not be debarred from that enjoyment provided she avoids undue fatigue ; and much the same applies to golf and even tennis in the first four months. But the patient who is not habituated to these forms of exercise is probably better to avoid them ; and all pregnant women should avoid violent exercise in the last four months. Long motor or train journeys should be avoided especially at the times corresponding to the suppressed monthly periods. Indeed every pregnant woman should make a special note of these epochs and make a point of taking more rest and of avoiding anything likely to cause fatigue of body or mind at these times. Obviously this restriction

should apply to social engagements. Late hours should be avoided throughout pregnancy, as ample sleep is essential.

Rest and Sleep.—In the last two months an hour's rest in the recumbent posture, and sleep if possible, may with advantage be enjoyed daily in the afternoon. At night the patient should have as much sleep as possible, with the bedroom window open. Sleeplessness is often experienced in the later weeks, and may be due to heartburn or tachycardia the result of hyperthyroidism (p. 153).

Bathing.—Very hot baths and very cold baths should be avoided. A daily warm or tepid bath is desirable, or if this is not possible, a daily sponging of the whole body with soap and warm water. In the last two months a multipara should avoid lying down in her bath as the soiled water may in that way gain access to the vagina. Sea bathing should be avoided in the later months, but may be allowed in the earlier ones if the water is not too cold and if the patient is accustomed to it and enjoys it.

Teeth.—The tendency to caries during pregnancy has been mentioned in connection with the calcium element in diet. Particular care should be taken to cleanse the teeth and gums at least morning and evening, and preferably after each meal. If any dental symptoms arise, a dentist should be consulted without delay. Oral sepsis is a definite danger in pregnancy even more than at other times. As explained elsewhere (p. 640), it may be a source of puerperal infection.

Breasts.—In the last three months attention should be paid to the preparation of the nipples for lactation. Flattened nipples should be drawn out with the finger and thumb once or twice daily. The nipples should be kept thoroughly clean by washing daily with a loofah or soft nail-brush kept for this purpose only. This toughens the skin sufficiently, and is better than the use of any spirituous lotions which tend to make the skin brittle and more apt to crack. If the breasts are uncomfortably heavy they should be supported by a loose brassière or supporting bandage.

Dress.—The clothing should be warm, loose and light. There must be no constriction of the abdomen, breasts or lower extremities. Garters should never be worn and stocking suspenders should take their place. Care should be taken that the lower limbs are warmly clad. Sometimes, especially in multigravidæ, a well-fitting elastic abdominal belt or "maternity" corset is a comfort, particularly in the latter months.

Marital Intercourse should be indulged in only at rare intervals in pregnancy. It should be avoided during the times corresponding to the menstrual periods and in the later months. It is particularly dangerous in the weeks before labour. There is every reason to suspect that some grave and even fatal cases of puerperal septic infection are the result of intercourse in the later weeks of pregnancy.

EXAMINATION OF THE URINE

No duty of the medical attendant is of more paramount importance than the systematic and periodic examination of the urine.

The urine must be tested for albumin, the presence of which is one of the earliest indications of commencing toxæmia. If recognised early and suitable treatment at once instituted, the serious developments of toxæmia—*e.g.* eclampsia—can, in most cases, be averted. Tests for sugar should also be made.

In addition, the urine should be examined for pus in every patient in whom there is the least suspicion of infection of the urinary tract, and in all cases of sickness tests for bile, acetone and diacetic acid should be made.

The urine should be examined at monthly intervals during the first six months and at increasingly frequent intervals during the last three months of pregnancy (p. 214). The patient should be told to report at once if her urine becomes scanty or if any swelling of face or hands, headache, nausea, or eye symptoms develop suddenly. Any complaint of headache demands immediate attention as it is so often the precursor of grave albuminuria and toxæmia (p. 209). The same applies to backache which may be the first indication of pyelitis (p. 262).

EXAMINATION OF BLOOD-PRESSURE

The blood-pressure often gives the first warning signal of danger ahead, especially in pre-eclamptic toxæmia and chronic renal disease. Very frequently a rise in blood-pressure precedes the appearance of albumin in the urine. The blood-pressure should be noted at regular intervals from the fifth month onwards. It is often lower than normal and should not exceed $\frac{130}{70}$.

BODY-WEIGHT.

The possible significance of any undue increase in the body-weight in pregnancy has only recently been appreciated. Normally there is a steady gain in weight from the beginning of the fourth month until a few days before labour. On an average this gain equals about a pound a week, but there are considerable individual variations. Any increase which is double the average may be considered abnormal, and its significance is that it may be due to occult œdema of the tissues, and that this occult œdema may be the very earliest symptom of pre-eclamptic toxæmia. In the present state of our knowledge it is impossible to be more dogmatic, but any such undue increase in weight should determine a particularly close watch for any rise in arterial pressure or albuminuria. This particular examination possesses the advantage that it can be carried out in any doctor's consulting room.

EXAMINATION OF THE PELVIS

Examination of the pelvis is of particular importance in primigravidae to determine its conformation and to detect possible contraction in view of the future conduct of the labour (*vide* p. 389).

It is well to examine the pelvis of a primigravida, by external measurements at least, when first she comes under observation. Subsequently a careful vaginal exploration should be made at the thirty-sixth week at latest and a clear idea formed of the general capacity of the pelvis. Many obstetric specialists advocate a radiographic examination as a routine—by both antero-posterior and lateral views—and there is much to be gained by this procedure provided very minor variations of pelvic deformity are not unduly stressed.

An approximate estimate of the size of the foetal head in its relationship to the pelvic brim cannot be arrived at till the thirty-sixth week. If the foetal head has not engaged in the true pelvis in a primigravida by that time a careful examination of the relative proportion of the head to the pelvis should be made (p. 526).

In the case of a multigravida who gives a history of previous difficult labour or still-birth, the pelvis should be carefully examined both by external measurements and by vaginal exploration (pp. 522 to 527).

EXAMINATION TO DETERMINE PRESENTATION AND POSITION OF FŒTUS

This examination should also be made in the thirty-sixth week when the pelvis is measured. In practically every case the *presentation*, and in a large number of cases the exact *position*, of the child can be determined by abdominal palpation (*vide* pp. 385 to 389). In the very few cases in which this is not possible a radiograph may be taken to remove all uncertainty. Such an examination is also advisable if plural pregnancy is suspected and in all cases of hydramnios.

In many cases malpresentations can be rectified—for example, the breech or shoulder can be converted into a vertex. The manner in which correction should be effected is discussed in connection with each malpresentation and malposition.

THE ANTENATAL CENTRE

The emphasis which is placed on antenatal care in modern obstetrics and its widespread practical application are developments of the present century. In Great Britain the first step was the endowment of a bed in the Royal Maternity and Simpson Memorial Hospital, Edinburgh, in 1901, for the specific purpose of treating the diseases of pregnancy. The importance of this development was only slowly apprehended, and it was more than a decade later that the idea of the

Out-Patient Clinic for giving advice to all expectant mothers in both normal and abnormal pregnancies found practical expression. In 1915 the public conscience, roused by the deplorable physique of multitudes of recruits to the Army, focused the attention of Parliament on the allied subjects of Infant Welfare and Maternity Welfare, with the result that grants were allocated to Local Authorities for the purpose of fostering these movements. Since then progress has been rapid and antenatal care is now subsidised all over the country, either through public clinics or by private doctors under various enactments, and every maternity hospital has its quota of beds set aside for the treatment of diseases and disorders of pregnancy.

The results have not yet been as beneficial as was to be expected. For this there are several reasons. *One is that many antenatal clinics under Local Authorities are staffed by whole-time officers who have no responsibility for the patients in their deliveries, and who are therefore unable to gain the practical experience to be derived from following cases through pregnancy, labour and the puerperium.* Another, which arises out of the lack of obstetrical experience just mentioned, is that in the first flush of enthusiasm there has been a tendency to stress minor abnormalities unduly and to advise unnecessary inductions of labour, etc. A third is that many members of the profession have not yet fully grasped the potential value and importance of this work, and that much so-called antenatal care is perfunctory.

From the point of view of constructive antenatal care (see p. 186) it is important that the Antenatal Centre should be made as attractive as possible to the expectant mothers, and that they should be welcomed sympathetically and encouraged to bring their multifarious problems and difficulties to the notice of the Staff. Much depends on the attitude of the nurses at the Centres in this respect.

The medical routine of such a Centre embodies the various points already discussed, and need not be repeated. The nature and extent of the examination made at any one visit depend, of course, on the period of gestation at which the patient first comes to the Centre. If, as is desirable, the first visit is made during the first three months, the main points are the establishment of the presumptive diagnosis of pregnancy, a general medical survey of the patient, the taking of the history as to previous health and previous pregnancies (if any), inquiry into such symptoms as vomiting, and the giving of advice as to diet, care of the teeth, regulation of the bowels and general hygiene. A Wassermann test should be made as a routine, if possible, and a careful investigation made of any vaginal discharge. Whether gonococcal or not, such discharges should be treated during pregnancy in order that the vagina may be rendered as far as possible devoid of infection before labour ensues. At this first and at each subsequent visit every patient should be given a date for her next visit, the interval varying from a few days to a month according to circumstances.

From mid-term onwards particular attention must be paid to the early detection of any symptoms of toxæmia. The urine must be examined at each visit, the blood-pressure taken and the body-weight noted—in the last six weeks these examinations should be made every week or ten days.

About the thirty-fourth to thirty-sixth weeks the pelvis should be examined as to its capacity and the presentation and position of the foetus noted (for details see pp. 384 to 390). If any disproportion is anticipated the appropriate lines of treatment should be considered and suitable arrangements made, if necessary, for the admission of the patient to hospital. This is also the period of gestation at which external version for breech presentation in primigravidæ can most favourably be attempted.

In normal cases the patient should be seen again a fortnight before term, so that the urine may be again examined and the presentation and position confirmed. In abnormal cases frequent visits may be necessary; and at any time admission to hospital or a nursing home may have to be arranged because of such conditions as hyperemesis, cardiac disease, pyelitis, antepartum hæmorrhage, toxæmia or any other condition requiring watchful care, nursing, rest and treatment. We desire to stress the advisability of institutional treatment for all patients showing abnormalities of any consequence during pregnancy or likely to have a difficult or complicated delivery.

A strong case can be presented for institutional treatment for all primigravidæ. The first confinement is full of uncertainties, consequently every possible precaution should be taken that, should any difficulties or complications arise, they can be dealt with under the most favourable conditions, in suitable surroundings, and with adequate assistance.

PART III
PATHOLOGY OF PREGNANCY

CHAPTER XI

THE TOXÆMIAS OF PREGNANCY

Hyperemesis Gravidarum—Acute Yellow Atrophy of Liver—Albuminuria—Pre-eclampsia—Eclampsia—Cortical Necrosis of Kidney—Other Toxæmias.

INTRODUCTION

THE state of pregnancy in human beings has already been referred to as *symbiose harmonique homogène*, qualified by the conditions that mother and foetus must be in good health and have adequate nutrition (p. 130). While the majority of pregnancies may be described in these terms, there is unfortunately a large number in which serious danger threatens the mother, and consequently the foetus. It is not to be wondered at that women with well-established systemic lesions are liable to exacerbations and recurrences under the strain of pregnancy, but much more disturbing is the fact that perfectly healthy women may develop serious and even fatal lesions in the course of pregnancy. These lesions appear to be definitely induced by the pregnancy, very often without there being any deviation in the development of the ovum itself. Such lesions are grouped together and, for want of a better name, designated as the toxæmias of pregnancy, and are usually divided into the toxæmias of the early months, the most striking example being *hyperemesis gravidarum*; and those of the later months, of which the most characteristic is *eclampsia*, but including the clinical states associated with albuminuria, raised blood-pressure or œdema which may develop into *eclampsia*. *Acute yellow atrophy of the liver* is grouped with the toxæmias of pregnancy, though it is not so characteristically a disease of pregnancy as the others. In recent years there has been a tendency to include *accidental hæmorrhage*, which occurs in the later months, in the category of the toxæmias. Less dangerous lesions, such as excessive salivation, herpes, pruritus and neuritis, occur from time to time, and appear to come into the same category.

While *hyperemesis gravidarum* presents a very different clinical and pathological picture from *eclampsia*, there are investigators who regard both as varying phenomena, resulting from the same ætiological factors, and indeed would trace back all toxæmias to the destruction of the endometrium by the developing ovum and the disturbances induced by that process.

The toxæmias of pregnancy have been, through many decades, studied from the clinical and pathological sides, and every year adds many volumes to the extensive literature on the subject. The methods of investigation tend to follow current researches in other branches of medicine: autointoxication, complement deviation, anaphylaxis, endocrinology, deficiency diseases and electrochemical changes have all been called on for possible explanations. Even to-day the subject is teeming with opinions and theories.

The anatomical and physiological changes occurring in pregnancy have already been described in Chapters VI and VII. There is hardly an organ in the body in which structural or functional deviations cannot be identified. A disturbance in the balance of those changes in the biochemical or the endocrine activities of the body could certainly produce a very serious result for the mother. Among those deviations it is difficult to distinguish between cause and effect. Does the ferment activity of the trophoblastic villus disturb the cell activities of the endometrium, or are both due to some action of the corpus luteum? Are the changes in the thyroid, parathyroid, pituitary and suprarenal glands the causes of the variations in protein, carbohydrate, fat and mineral metabolism, or are all the harmonious result of a stimulus produced by the ovum? It is hardly likely that mere mechanical processes, such as the pressure of the enlarging uterus, even if it were the cause of intestinal stasis, could produce such widespread effects.

Among the earliest recognisable disturbances in pregnancy is the change within the endometrium, brought about by the activity of the trophoblastic villi. This digestion and liquefaction of tissue, occurring in the very course of the maternal blood-stream, may give rise to decomposition products which have a toxic action on the maternal organism. We may have here the cause of morning sickness. Well authenticated case records have shown morning sickness to occur as early as the tenth day after conception. Where the decidual response is not adequate, the toxic action may be increased and so give rise to the more serious form of vomiting, viz., *hyperemesis gravidarum*. This condition may be particularly severe where the ovum is grossly abnormal—for example, in a hydatidiform mole, where the activity of the epithelial covering of the chorionic villi is certainly increased (p. 300).

The albuminuria, which may be the precursor of eclampsia, usually occurs at a much later stage of pregnancy, at a time when so many blood and tissue changes have already occurred that it is impossible to identify the actual causal factor. So many views have been held regarding the cause of eclampsia, since the association of albuminuria with this condition was discovered by Lever in 1843, that there is good reason for the description of eclampsia as the “disease of theories.”

HYPEREMESIS GRAVIDARUM

The term *hyperemesis gravidarum* is restricted here to the characteristic clinical condition which occurs in the early months of pregnancy. Where excessive vomiting occurs in the later months many ætiological factors have to be considered, and a careful diagnosis made before treatment is instituted. This condition is described later in this chapter (p. 206).

In some women the morning sickness of pregnancy assumes a very grave form. Morning sickness occurs in about fifty per cent. of pregnant women, though in the milder cases there may be only a feeling of nausea or the ejection of a mouthful of fluid. In others some undigested or partly digested food may be expelled; in graver cases the sickness may persist throughout the day, and apparently all the ingested food is returned.

This last type is a very grave condition and is described as *hyperemesis gravidarum*. From this great interference with the taking of food there appear not only the signs of starvation, but also the indications of an acute toxæmia, with wasting, acidosis and even coma, leading to the death of the patient.

It is most important to realise that hyperemesis of a grave nature very seldom develops if emesis is energetically treated—it is almost a preventable disease. Even when emesis has assumed a graver form, early treatment can secure very satisfactory results. In a series of 100 cases treated in Glasgow Royal Maternity and Women's Hospital for *hyperemesis gravidarum*, including 34 cases graded as of moderate or great severity, there was only one fatal case and only one in which it was found necessary to terminate the pregnancy—both those women had been ill for a long time before admission.

Formerly three clinical types of this disease were described: (1) the *neurotic* type, found particularly in women of a nervous temperament in whom treatment by sedatives and by "suggestion" might stop the vomiting; (2) the *toxæmic* type, where the only cause was presumed to be a toxæmia, and which in its fully developed form responded to no form of treatment other than the termination of the pregnancy; and (3) the *reflex* type where there was some local lesion, such as a retroversion or exaggerated ante flexion of the uterus, the correction of which brought relief to the general condition. Pelvic abnormalities of this type, however, were very often present without the patient suffering from even morning sickness.

In view of the more careful study of this hyperemesis we may reduce the clinical varieties to two—the *neurotic* and the *toxæmic*—which are very closely related to each other. There is now a consensus of opinion, as has been suggested earlier (p. 197), that probably a mild toxæmic basis underlies even ordinary morning sickness. In nervous women this tendency to vomit may become an obsession

and lead to the fully developed neurotic type. Later the neurotic type, if it is not controlled, may cause such grave disturbance of the metabolic processes that the patient will merge into a condition of rapid emaciation and acidosis, and die from an acute toxic lesion. It is most important to remember how suddenly, in fact precipitately, this transfer from the apparently neurotic to the true toxæmic type may occur. The patient may present a fairly healthy appearance apart from the fact that she retches whenever she has even a drink of water: then within forty-eight hours she may show progressive emaciation, shrinking of the skin and jaundice. The most practical

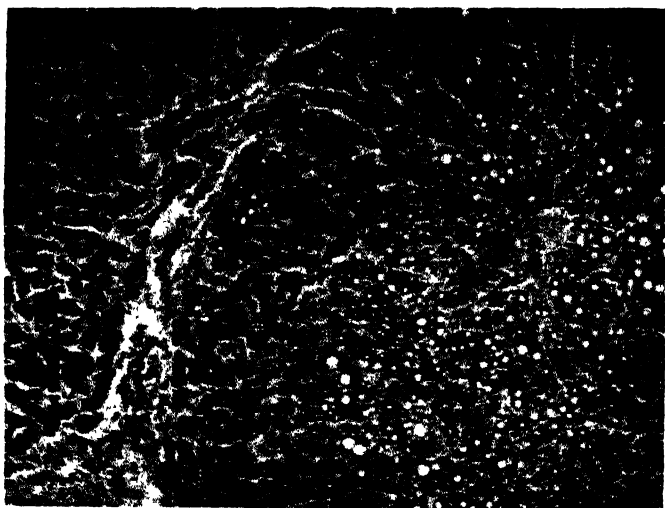


FIG. 82.—Liver in Hyperemesis. The cells near the central vein on the right show large vacuoles due to fatty change. The cells near the portal tract on the left are almost unaffected. (H. L. Sheehan.)

classification is on the basis of clinical severity—the more severe the clinical condition, the more marked is the toxæmic change.

The old reflex variety is probably a mild toxæmic variety in which correction of a local pelvic abnormality acts on the patient as in the form of treatment by suggestion.

PATHOLOGICAL LESIONS.—*The Liver.*—For many years the standard pathological lesion of the liver associated with *hyperemesis gravidarum* has been regarded as a central necrosis in the lobule surrounded by an area of fatty degeneration and then by a layer of healthy liver tissue, which may be reduced to a mere shell, round the periphery of the organ. Specimens have been described in which as much as 90 per cent. of the liver tissue had been thrown out of action, but such extensive lesions are very rare. The post-mortem findings are most variable, and in many cases there is little or no obvious change (Fig. 82). There may be only a series of small necrotic patches in the centres of some of the

lobules, while the bulk of the organ appears quite healthy. In other cases only a few of the liver cells show fatty infiltration, while in others again there may be extensive fatty degeneration affecting the whole organ. The last type is usually found in women who die after a long illness, and the lesion is more characteristic of starvation than of acute toxæmia. Where the necrotic changes are marked the histological picture resembles very closely that found in acute yellow atrophy of the liver—a central necrosis spreading from the centre of the lobule and regarded as characteristic of a systemic toxic process. This lesion is certainly found in patients who have been anæsthetised with chloroform for the termination of the pregnancy, and is more likely to be the result of the chloroform. At one time great stress was laid on the different distribution of necrosis in the hepatic lesions of hyperemesis and eclampsia, central in the former and peripheral in the latter, but central necrosis is quite frequently found in the livers of eclamptic patients (p. 222).

The Kidneys.—The kidneys may show no change, but there is sometimes a fatty degeneration of the first convoluted tubules. The extensive necrosis of the convoluted tubules which is occasionally described is probably due to post-mortem autolysis.

PATHOLOGICAL CHEMISTRY.—While the biochemistry of this condition has been extensively studied, there are few phenomena which may be considered constant and characteristic. The most notable changes in the blood and the urine are due to starvation rather than toxæmia, and it is only in the most severe cases that evidence of gross tissue destruction can be identified.

Vomiting produces dehydration and reduces the carbohydrate intake. The glycogen reserve of the liver is used up, and the body has to live on its own fats and proteins. The oxidation of the fats is incomplete owing to the shortage of carbohydrate and consequently β -hydroxybutyric acid, diacetic acid and acetone circulate in the blood and appear in the urine. The hydrogen-ion concentration of the blood is stabilised at this stage by the excretion of a larger amount of nitrogen as ammonia, instead of as urea, and the *ammonia coefficient* rises. This coefficient, indicating the proportion of the total nitrogen in the urine which is excreted as ammonia, rises from the normal figure five to ten, twenty or even higher. While a high ammonia coefficient was at one time regarded as diagnostic of the toxic form of vomiting, its only significance is as an index of the state of starvation in the tissues. When necrotic changes occur in the liver, the excretion of bile is interfered with and bile appears in the urine. Should the destruction of liver cells continue, there will be a large increase in the nitrogen content of the blood, chiefly in the form of urea. This will give a very characteristic picture of an adequate excretion of nitrogen by the kidneys, with the non-protein nitrogen of the blood approaching figures which occur in uræmia, and is sometimes found in the terminal

stages of hyperemesis. Occasionally in severe cases the acetone bodies disappear from the urine, and this change is probably due to the body proteins being broken down when the fat reserve is exhausted.

The most constant findings are the occurrence of acetone bodies in the blood and the urine, and the increased ammonia coefficient. In severe cases the blood shows an increase in the non-protein nitrogen, uric acid, urea, and amino and lactic acids, with a decrease in the chlorides. This decrease is probably the result of dehydration, and may be associated with the absence of free hydrochloric acid from the gastric secretion, frequently observed in such cases. The chlorides in the urine are also decreased. The carbon-dioxide combining power of the blood remains normal, except in severe cases, and even then the acid-base equilibrium, as indicated by the hydrogen-ion concentration, remains within normal limits. The blood-sugar may be slightly raised in severe cases, but is usually unchanged.

INCIDENCE.—*Hyperemesis gravidarum* occurs in about one out of 700 cases, but this incidence varies in different countries. France and the United States show a greater incidence than Great Britain, and Scotland than England and Wales. The disease occurs usually in the second or third, more rarely in the fourth, month. It occurs in multi-gravidæ as in primigravidæ, and may occur in the same woman with successive pregnancies.

SYMPTOMS.—The ordinary sickness of pregnancy becomes greatly exaggerated: the patient loses her appetite and the stomach becomes intolerant of solid food and even of all liquids. Anorexia may develop into loathing of food: the mere mention of it may bring on retching. At first confined to the mornings, then spreading through the day, the vomiting may eventually disturb the patient right through the night. She complains of severe epigastric pain, and of pain in the ribs, due to the excessive retching.

The vomit, which is at first composed of bile and mucus, may eventually have the appearance of “*coffee-grounds*” from the presence of altered blood. The urine is scanty and high-coloured and contains albumin, casts, bile, acetone, diacetic acid and sometimes glucose.

When the toxæmic type is established, dehydration and emaciation occur, and the patient loses weight up to the amount of 20 or 30 lbs. The skin becomes pale, dry and shrunken with a definite yellow tinge which may develop later into deep jaundice. The abdomen becomes scaphoid, and there is great tenderness over the stomach and liver. While the lips may be dry and cracked, *they are often full and of a bright red colour*. The gums are covered with sordes, the tongue dry and cracked, and there is a heavy odour of acetone from the breath. The temperature may be subnormal, but pyrexia up to about 101° may occur, especially in the more acute cases. The pulse-rate rises, its volume deteriorates, and the systolic blood-pressure falls to under 100. Routine eye examination may reveal a hæmorrhagic

retinitis, which is to be regarded as a very grave sign. In the terminal stages torpor or occasionally violent excitement, passing into coma, occurs. Not infrequently in the gravest forms there occurs for a day or two before death a cessation of vomiting, which may be mistaken for an improvement in the patient's condition.

Clinical Course.—The disease is usually slowly progressive, until wasting first appears, from which point the downward progress may be very rapid. There are, however, cases in which the onset and development are so sudden as to deserve the name "fulminating type." In the latter case, death may occur within ten days from the first disturbance, whereas in the ordinary type the condition may drag on for four or five weeks. Special care must be taken with those patients who appear to have made a satisfactory recovery and then within a week or two have a sudden acute relapse: their resistance has already been reduced and the relapse may take almost a fulminating course.

DIAGNOSIS.—The first step in diagnosis is to make certain that the vomiting is not due to any of the ordinary causes of pathological vomiting—*e.g.* chronic intestinal obstruction, strangulated hernia, gastric ulcer, chronic alcoholism, cerebral tumour, or the onset of an acute specific fever. Then, again, we have to consider other conditions in pregnancy which may be associated with vomiting—as, for example, hydatidiform mole, pyelitis, or acute hydramnios, but vomiting from those causes is considered later.

When a decision has been reached that the excessive sickness is solely due to the existence of an early pregnancy, treatment on the lines indicated in the following paragraphs should be instituted. The prognosis depends on the response to treatment.

TREATMENT.—In the treatment of *hyperemesis gravidarum* we are handicapped by the uncertainty of its aetiology. On the assumption that endocrine irregularities may be responsible, series of cases have been treated with corpus luteum extract and with desiccated placenta—in neither instance have uniform results been obtained. Cures have been reported following the injection of 10 or 20 c.c. of serum obtained from a normal pregnant woman, but this form of therapy may fall into the category of treatment by suggestion. Symptomatic treatment with gastric sedatives, such as dilute hydrocyanic acid or bismuth and soda mixtures, may be successful in mild cases. Only an empirical basis can be advanced for the use of cerium oxalate or dilute tincture of iodine, by which success is occasionally achieved. Gastric analysis would sometimes justify the administration of dilute hydrochloric acid before meals. Sedative treatment on wider lines will be referred to later—for this purpose bromides, chloral, or luminal may be employed. There is a type of patient in whom encouragement and reassurance, reference to the prospect of motherhood, and a degree of psychic control will be sufficient. This *hyperemesis* type of case is certainly

one in which suggestion exercised by relatives, or by the medical attendant and nurse, may have a very great influence—by the relatives, unfortunately, almost always adversely.

While different cases may respond very differently to treatment, it is a great advantage to have a definite scheme based on definite therapeutic principles. Harding and Watson did a great service by focusing attention on four ætiological factors which, while not defining the precise origin of *hyperemesis gravidarum*, form a useful guide to systematic treatment—(a) *Disturbed Carbohydrate Metabolism*, associated with the excessive needs of the foetus in this food principle. The foetus is unable to accumulate any reserve of carbohydrate within its own tissues until the seventh month. The mother must have a constant supply available, and may therefore suffer a great depletion of her own reserves, and even require to draw upon her fats and proteins for this purpose (p. 143). (b) *Neurosis*: There may be some relationship between disturbed carbohydrate metabolism and the sympathetic nervous system. On the other hand, the special liability of the nervous type of woman to this disease has already been referred to. (c) *Alimentary Toxæmia*, associated with intestinal stasis. This stasis is not simply a mechanical effect; it is more probably due to an inhibitory influence on smooth muscle tissue, produced during pregnancy either by endocrine activity (p. 59) or by some abnormal metabolic product. (d) *Dehydration*: the result of the poor intake of fluid and the excessive loss by vomiting.

In accordance with this scheme the *mild case*, in which there is only exaggerated morning sickness, should be put on to a carbohydrate diet, including fruit, jellies and starchy food. It is useful to include vitamin B concentrates, such as Bemax or Marmite. To this may be added gradually fish and chicken. Food with a high fat content, such as bacon, salmon, etc., should be avoided. Frequent light meals should be taken—six small meals rather than three heavy meals. It is most important that she should have some light nourishment, such as Benger's Food, Horlick's milk, glucose solution, or even dry barley sugar, when she wakens in the morning or if she is awake during the night. The fluid intake should be ample, not less than 3 pints per day. Care should be taken to secure regular bowel movements. At this stage encouragement and reassurance are most valuable.

In *more advanced cases*, where there is frequent vomiting with or without continuous nausea, but no epigastric pain or jaundice, where very little food is retained, and dehydration appearing, more stringent measures are necessary. The patient should be moved to an institution or nursing home and isolated from her relatives, whose excessive sympathy, or even want of sympathy, may have an adverse influence. She must be kept in bed, and all nourishment by mouth stopped. Nutrition is secured by giving glucose in a 10 per cent. solution per rectum, preferably by the continuous drip method. If the rate of

administration is kept slow, under 10 ounces per hour, the patient may retain 4 or 5 pints in the first twenty-four hours. A sedative effect is secured by giving 40 grains of sodium bromide or 30 grains of chloral hydrate with the rectal glucose. If there is any difficulty with the drip method, or when it has been discontinued, the same strength of glucose should be given in separate enemata, carefully administered, containing not more than 6 or 8 ounces, at four-hourly intervals. Bromides or chloral should be continued in the last saline at night. The bowel should be cleansed with a single soap-and-water enema per day.

As the sickness is arrested, the patient is allowed sips of water by mouth; and by the end of twenty-four hours she is encouraged to drink freely. No food is given by mouth until she asks for it, and then the diet is on the lines indicated for mild cases. The glucose enemata are continued until the acetone bodies disappear from the urine. Protein is not added to the diet until the acetonuria disappears.

In the *most severe cases*, where there is continuous vomiting with epigastric pain, jaundice, complete inability to retain food, and marked dehydration, still more vigorous measures are required. Such patients require all the resources of an institution. It is essential that glucose should be supplied to the tissues as quickly as possible, and the intravenous route is the most favourable. Again the continuous drip method is the most satisfactory, and a 10 per cent. solution of glucose should be run into the antecubital vein, the rate being adjusted to give about 1 pint in four hours. In view of the diminution of chlorides in the blood (p. 202) it is helpful to add 0·5 per cent. sodium chloride to the glucose solution. From 4 to 6 pints can be given by this method in twenty-four hours. Where the patient is too restless to allow the continuous method, 1 pint of the glucose solution should be given intravenously every six hours. Where the veins are small, or access difficult, 1 pint of glucose of the same strength may be given intramuscularly, but this method causes considerable discomfort and can seldom be repeated. With this massive administration of glucose intravenously, there may appear symptoms of hyperglycæmia: this may be guarded against and storage by the liver in the form of glycogen encouraged, by the administration of insulin at the rate of 1 unit per 3 grams. of glucose. As a few cases of hyperemesis show alkalosis instead of the usual acidosis, insulin should be administered with the very greatest care.

During this phase of intensive treatment, sedatives of the bromide type should be administered in solution per rectum. Hiccup, which occasionally appears as a disturbing symptom in the most severe cases, may be controlled by the administration of 0·5 grain of codeine hypodermically. The administration of calcium gluconate intramuscularly—20 c.c. of a 10 per cent. solution—is recommended for the protection of the liver against the action of toxins, but in the series of one hundred

cases referred to (p. 199) this step was not found necessary. As improvement occurs the patient is carried through the treatment already described for the less severe, and then through that for the mild cases. Improvement is indicated not only by the general condition of the patient, but also by a rise in the amount of urine secreted, a marked reduction in the acetone bodies present in the urine, and by a fall in the pulse-rate.

Some cases may be so resistant to treatment that termination of the pregnancy offers the only hope of cure: the number of such cases should be very small (p. 199). *The important point in those obstinate cases is to terminate the pregnancy before the patient's condition is so poor as to make interference dangerous.* Even when evacuation of the uterine contents has been decided on, it is advisable to give intravenous glucose before operation. On general grounds it is more important to persevere with conservative treatment in a primigravida than in a multipara. Should a primigravida require to have her first pregnancy terminated, succeeding pregnancies may the more easily appear to require similar treatment. Before operation the anæsthetic requires special consideration. With such an amount of liver damage as may be present, chloroform is quite unsuitable. Ether may not only cause undesirable blood loss during the operation, but also be followed by bronchial irritation. The condition of the patient is usually too poor to permit spinal anæsthesia. Nitrous oxide with oxygen is the most satisfactory anæsthetic where the uterus is emptied from the vagina. When the abdominal route is chosen, most satisfactory results are obtained by the infiltration of the tissues with a local anæsthetic (2 per cent. novocain), nitrous oxide with oxygen being used as a supplementary anæsthetic where the patient proves hypersensitive or restless. The blood loss under those conditions is very slight.

The operation should be of the one-stage type, and for this reason slow dilatation of the cervix with tents is contraindicated. Where the cervix cannot be easily dilated, it should be incised and vaginal hysterotomy performed—usually a simple operation in a parous woman, but more difficult in a primigravida. There is now an increasing tendency to deal with such cases by the abdominal route: abdominal hysterotomy can be carried out expeditiously with a certain complete removal of the ovum, minimal blood loss, and relatively less shock than the more protracted vaginal operations.

When the uterus has been emptied, the patient's recovery may be extraordinarily rapid and complete. In the *fulminating* type of case very copious carbohydrate administration should be continued for several days after operation.

Excessive Vomiting in the Later Months of Pregnancy.—In the later months of pregnancy there may be persistent or excessive vomiting, but in most cases this will be found to be merely a symptom of some well-established and readily identified lesion. In cases of renal

inefficiency, due either to pre-eclamptic toxæmia or chronic nephritis, excessive vomiting may be a very disturbing symptom (p. 217). In pyelitis, especially the chronic form, vomiting may be so persistent as to cause inanition (p. 264). Its association with profound liver changes may lead to a diagnosis of acute yellow atrophy of the liver (p. 208). Multiple pregnancy, hydramnios, especially in its acute form, accidental hæmorrhage, and cases in which a hydatidiform mole persists into the second half of pregnancy, may cause persistent vomiting. Associated lesions, such as red degeneration in fibroid tumours, torsion of the pedicle of an ovarian cyst, or even the presence of a large ovarian cyst, are further associations. All the various diseases, which, apart from pregnancy, may cause excessive vomiting, have to be considered. When all those relationships have been studied, there still remains a small group of cases in which excessive vomiting during the later months appears to have been induced by an otherwise normal pregnancy. There may have been an earlier hyperemesis gravidarum which did not clear up completely. A few fatal cases seem to admit no more accurate diagnosis—there may be some central deposition of fat in the liver lobules and fatty degeneration of the first convoluted tubules of the kidney.

Most careful investigation is required, but when the diagnosis has been established by elimination of other causes, the principles to be followed in treatment are precisely those which have been described for cases of *hyperemesis gravidarum*—the administration of glucose and sedatives. The one important difference is that in the later months induction of premature labour may be resorted to with less compunction than the induction of abortion in the early months.

ACUTE YELLOW ATROPHY OF THE LIVER

Acute yellow atrophy of the liver, otherwise described as *Icterus gravis gravidarum*, is described here because of its resemblance to *hyperemesis gravidarum*, even though it most commonly occurs in the later months of pregnancy. This acute yellow atrophy is not peculiar to pregnancy, but over 60 per cent. of the recorded cases have occurred in pregnant women. It may occur as early as the second month, though it usually occurs in the later months, or in the first few days of the puerperium. The disease is due to one of the most profound types of toxæmia known, but the source of the toxin has not yet been discovered. Some of the cases described may have been due to chloroform poisoning (p. 413).

PATHOLOGY.—*Liver.*—The liver rapidly diminishes in volume, its capsule assuming a wrinkled appearance. Its weight may be only half the normal weight; its consistency is very soft; on section, the surface appears dark red, while close examination shows a series of

little red centres surrounded by yellow rings. Tiny hæmorrhages may be found under the capsule.

Microscopically, the centres of the lobules are found to be necrotic, and surrounded by areas of fatty degeneration. There may be a shell of normal hepatic tissue at the periphery of the lobule. The interlobular spaces remain unaltered. The changes are very similar to those described in the most severe forms of *hyperemesis gravidarum*.

Kidneys.—The kidneys present the signs of acute nephritis with degenerative changes in the convoluted tubules, the lumina of which are filled with casts and debris. The glomeruli and collecting tubules may appear normal.

PATHOLOGICAL CHEMISTRY.—The changes in the urine are very similar to those found in the more severe forms of *hyperemesis gravidarum*. The total nitrogen is usually increased, with a reduction in the urea fraction and a very high ammonia coefficient. There is a very marked increase in the amino-acids. The amount of urine is scanty, high-coloured, and contains albumin, bile, acetone bodies, and sometimes a great quantity of blood. This is one of the few conditions in which crystals of leucin and tyrosin are found in the urine.

The chemistry of the blood has been investigated in a few cases. The total non-protein nitrogen is increased, the urea nitrogen within normal limits, but the uric acid and amino-acids are very much increased. The amino-acid nitrogen may even exceed the urea nitrogen and this appears to be due to the autolysis of liver cells. The sugar in the blood is reduced. The carbon dioxide combining power of the blood is greatly reduced, indicating a relative or developing acidosis.

SYMPTOMS.—The onset may be sudden or gradual. In the former case, the symptoms resemble phosphorus or some other form of poisoning. The patient, apparently in perfect health, is suddenly seized with headache, violent griping pains, vomiting and severe diarrhœa. The course is very acute: torpor or delirium with extreme restlessness occurs; very soon coma supervenes, accompanied sometimes by convulsions. Jaundice, sometimes of a very marked type, appears very early. The pulse-rate becomes very rapid, and the temperature, at first subnormal, rises sometimes to a very high point. The blood-pressure remains normal until renal function fails. The state of coma may be terminated in a few hours, sometimes in several days, by death. Recovery is unusual.

In most cases the course is much more gradual. The early symptoms are those of a pre-eclamptic toxæmia. The patient complains of headache, vomiting, constipation, epigastric pain and extreme weakness. Jaundice soon appears, and careful observation reveals the fact that the liver dullness is diminishing. The patient becomes more and more apathetic, and gradually passes into a state of coma. Sometimes a still-born child is delivered spontaneously and the foetal

liver and kidneys show the same type of lesions as have been described in the mother. Most of those cases also end in death. The prodromal symptoms described above may change suddenly into the symptoms of the acute type.

The symptoms are the same whether the disease appears in pregnancy or in the puerperium.

DIAGNOSIS.—In association with pregnancy, this condition may resemble severe pre-eclamptic toxæmia or eclampsia; but the deep jaundice, the diminution of liver dullness, the low blood-pressure and the abnormal constituents in the urine give a clear differentiation. In the puerperium this condition may be mistaken for a fulminating puerperal infection, and diagnosis may only be established at autopsy. Should the puerperal infection be due to the very rare *Bacillus welchii*, differential diagnosis is almost impossible. Another immediate puerperal condition which may cause difficulty in diagnosis is delayed chloroform poisoning, but the history of the administration of chloroform one or two days before the onset of symptoms indicates the nature of the toxin. The child is practically always lost.

TREATMENT AND PROGNOSIS.—The prognosis in these cases is very bad: few recover. If the condition occurs in pregnancy, the uterus should be emptied as rapidly as is consistent with the condition of the patient, and abdominal hysterotomy under local anæsthesia (p. 421) provides the most efficient method. The general treatment should be by the intravenous administration of glucose, as described for the most severe cases of *hyperemesis gravidarum* (p. 203). The impairment of renal function in those cases renders them specially liable to develop ketosis during treatment. Alkalis in the form of bicarbonate of soda should be given by mouth or per rectum to prevent acidosis.

PRE-ECLAMPTIC TOXÆMIA

In this section are considered those patients in whom the later months of pregnancy are disturbed by one or more of the three cardinal signs—albuminuria, raised blood-pressure and œdema—all associated with a tendency to the development of eclampsia. These changes appear in this group to be entirely due to the pregnancy: the association of pregnancy with chronic nephritis will be considered in the following section (p. 216). The term *pre-eclamptic toxæmia* has been employed here, partly for convenience of classification, but also as recognising the separate importance of each of the three signs: this same clinical group may be found described as *Pregnancy-Kidney*, *Albuminuria of Pregnancy*, *Hypertensive Toxæmia*, or *Late Pregnancy Toxæmia*. The arrangement of the section is based on albuminuria as probably the most frequent, though not necessarily the most important, sign.

In over 5 per cent. of pregnant women, particularly in primigravidaë,

a trace of albumin will be found in the urine by such routine tests as boiling or the use of nitric acid : when finer reagents, such as potassium ferrocyanide, are used, a positive reaction will be found in about one-third of all pregnant women. The type of case considered here is that in which there is no evidence of any preceding or continuing nephritis (p. 216). This newly-established albuminuria has already been ascribed to a mild toxæmia, and the examination of the kidneys in cases of eclampsia indicates that the toxin affects the walls of the glomerular capillaries (p. 223). The obvious 5 per cent. referred to above is found to include the larger proportion of such abnormalities in pregnancy as hydramnios, plural pregnancy and hydatidiform mole. Subjective symptoms associated with this albuminuria may never appear, but when they do they usually occur in the later months of pregnancy. The condition when identified generally responds to treatment ; but, if neglected, it may develop into true eclampsia. Occasionally, eclampsia develops even when the patient has been under what is usually satisfactory treatment—the *fulminating* type (p. 227).

Recurrent Slight Albuminuria.—In some women slight albuminuria appears within the last three months in successive pregnancies. The actual amount of albumin seldom reaches two parts on the Esbach scale, and is frequently less than one part. The amount of urine excreted is normal and renal functional tests, such as the rate of excretion of indigo-carmin and the urea concentration test, give normal readings. The blood-pressure is slightly raised, but the systolic pressure seldom exceeds 150 mm. Hg. and the diastolic pressure is under 90. There is in most cases some œdema of the ankles, and the subjective symptoms, if any, are limited to headache and slight malaise. The albuminuria shows little tendency to increase during the pregnancy, but while it can be easily controlled by rest in bed and a restricted diet, treatment fails to clear up the condition entirely. The albuminuria disappears during the puerperium, though sometimes not until a few weeks after labour, and careful examination some months later shows no trace of functional impairment. In her next pregnancy the same train of events will occur, the time of appearance and the degree of albuminuria being practically the same. Those women may pass through several pregnancies with the same slight disturbance and little trace of after-effects ; but continued observation of such patients has shown that a large percentage eventually develop persistent hypertension, cardiac enlargement, retinal sclerosis, and other signs of cardiovascular disease—in one group 50 per cent. showed persistent hypertension at the end of five years.

Earlier experience of this apparently minor disability seemed to justify the belief that in those patients there was some congenital renal defect, just sufficient to support the metabolic processes apart from pregnancy, or that the kidneys had a poor functional reserve—

the *low reserve kidney*. This latter view was based on the belief that under normal circumstances all the glomeruli of the kidney are not in full function at one time, and that there is a margin of safety of almost 50 per cent. against times of special strain. If this margin is low, then the extra strain of the later months of pregnancy will exhaust the reserve and cause albuminuria, œdema and a rise in blood-pressure. Further experience and observation of the later clinical records of the patients have made it clear that this mild recurrent albuminuria is due to a mild toxæmia—the difference between this and progressive albuminuria being only one of degree.

Progressive Albuminuria.—This term may be conveniently applied to the more frequent and more severe type of albuminuria which may appear at the same stage of pregnancy, but which tends to increase in severity with the progress of the pregnancy. While the amount of albumin may be small at first, it tends to increase and may rise to as much as 20 parts on the Esbach scale. In the heat test the coagulum is very dense owing to the large proportion of globulin present. The amount of urine secreted tends to diminish as the condition progresses.

Before albumin appears in the urine there is usually œdema and a rise in blood-pressure. The condition has such serious possibilities that it is important to detect it at the earliest possible moment. The first sign is usually œdema—not the easily recognised surface œdema which spreads from the feet and legs to the vulva, the upper limbs and sometimes the face, and which appears later—but an accumulation of fluid in the deeper tissues. Such a condition, described as *occult œdema*, should always be suspected when there is an abnormal increase in weight. The steady increase of weight month by month, characteristic of normal pregnancy (p. 190), has been standardised, and when the increase in one month exceeds 5 lbs. a toxic albuminuria is found to occur in about 50 per cent. of the patients. This œdema is not necessary for the development of severe albuminuria—œdema may be absent in the most severe cases of eclampsia and such absence is regarded as an unfavourable sign. Associated with the œdema there is usually very marked pallor.

A rise in blood-pressure usually occurs after œdema has been recognised, but may precede the actual albuminuria by two or three weeks. A rise in the systolic blood-pressure to 180 is usual in such cases, but this may become increased to 200 with a diastolic pressure of 120. The routine estimation of blood-pressure is one of the most reliable and convenient methods of identifying toxæmic tendencies in pregnant women, and antenatal supervision without such records cannot be accepted as efficient.

As the condition progresses the patient frequently complains of severe headache, usually frontal in character. She may complain of flashes of light or black spots before her eyes, dimness of vision or even

complete blindness. The routine examination of the eyes in cases of albuminuria in pregnancy is most important for exact diagnosis and prognosis. By the time that eye symptoms appear, œdema and sometimes separation of the retina can be identified: in severe cases there may be small hæmorrhages and patches of exudate. The appearances may resemble very closely the changes in Bright's disease, and retinitis can no longer be regarded as proof of a pre-existing nephritis—it may only be a measure of the severity of the toxæmia. Arterio-sclerotic changes in the retinal vessels, however, are diagnostic of pre-existing renal or arterial disease.

Vomiting with epigastric pain, more severe headaches or drowsiness with sometimes slight mental disturbance, occurring in a case of severe albuminuria may be the immediate precursors of the onset of eclampsia, and must be regarded as very serious symptoms. While eclampsia is the usual fate of patients in whom severe albuminuria of this type has not been diagnosed, or has failed to respond to treatment, a few women pass from extreme drowsiness to coma and death.

PATHOLOGICAL CHEMISTRY.—The reduction in the volume of urine excreted and the high content of albumen and globulin has been referred to. The urea and the chloride content are very low. In the more severe cases there are usually large numbers of casts and many blood cells: in slight cases a few casts may be identified. Pus cells are accidental, as this type of hypertensive toxæmia is seldom associated with pyelitis (p. 262). Acetone may be present.

The blood proteins show very low values, down to 4 or 5 mg. per cent., and this may be of importance in the production of œdema. The proportions of globulin and fibrinogen to albumen are even higher than in normal pregnancy. There is no evidence of nitrogen retention—the non-protein nitrogen is within normal limits and the urea as low as in normal pregnancy. The uric acid is increased, but the calcium is at the lower limit of normal values. The chlorides are reduced and the carbon dioxide combining power is diminished.

DIAGNOSIS.—The great problem here is to differentiate pre-eclamptic toxæmia from an old-standing nephritis complicated by pregnancy (p. 216). The latter is not a primary toxæmia, although it is a condition which may become much worse during pregnancy. Occasionally the patient may help the physician by giving a history of a previous attack of nephritis or a history of some illness which is often followed by permanent injury to the kidney, such as scarlet fever or diphtheria.

In the nephritic patients also there are usually cardiovascular changes—thickened arteries, raised blood-pressure and cardiac hypertrophy. Again the urine, before pregnancy occurred, was increased in amount with very little albumin; and this condition continues throughout pregnancy, unless the kidneys give way under the strain.

Pre-eclamptic toxæmia occurs most frequently in primigravidæ (about 70 per cent.) with no history of a previous kidney renal lesion,

and is about four to five times more frequent in plural pregnancy. The symptoms do not usually make their appearance until the second half of pregnancy, whereas the albuminuria of nephritis may be discovered early in the first half.

Laboratory investigations are disappointing as an aid to differential diagnosis. Examination of the blood and the urine does not show any great difference until definite renal inefficiency develops in the nephritic case. Then the non-protein nitrogen of the blood may rise from 20 to 40 or 45 mg. per cent., with a corresponding rise in the blood urea—indicating definite retention of nitrogen. The uric acid content in the pre-eclamptic type is usually higher—4 to 6 mg. per cent.—than in the nephritic type—2 to 4 mg. per cent.—but the figures are not sufficiently definite to allow a differential diagnosis. The carbon dioxide power of the blood in pre-eclampsia is diminished to about 40 volumes per cent., whereas this value in nephritic cases remains at the figure for normal pregnancy—48 volumes per cent. The urea concentration and urea clearance tests give low figures in both cases, without any such difference as would provide a basis for differential diagnosis.

We may have some assistance in differential diagnosis from the extent to which the condition clears up at the end of the pregnancy. Where the signs and symptoms disappear entirely within a week or two, it is likely that the disturbance was due to a toxæmia. Even in such cases the urea clearance test may take three or six months to regain normal values. If the signs of renal inefficiency persist, we have still the alternatives of there having been an organic lesion before the pregnancy started, or that a severe toxæmia has now produced permanent renal damage.

PROGNOSIS.—The immediate prognosis depends essentially on the response to treatment. In the recurrent slight type there is seldom any reason for immediate anxiety, but a succession of pregnancies with this minor functional disturbance must increase liability to the permanent lesion which has been found eventually in a large percentage of such patients. In progressive albuminuria the condition usually responds to treatment, and a healthy child may be born at term. Where a marked albuminuria persists in spite of treatment, there may be a premature labour with the birth of an ill-nourished or even a macerated fœtus. “Accidental hæmorrhage” (p. 584) may occur in this type, but more frequent is the onset of eclampsia.

The longer the albuminuria persists, the worse is the ultimate prognosis. Where severe albuminuria develops quickly, does not respond to conservative treatment and requires the early termination of the pregnancy as the only means of preventing the onset of eclampsia, or where eclampsia appears in its *fulminating* form (p. 227), the late prognosis appears to be more favourable than in the more protracted cases. Recent investigations show that where a

marked albuminuria had persisted in a pregnant woman for two weeks, under careful treatment, whatever be the fate of the present pregnancy, the patient develops chronic nephritis in about 10 per cent. of cases. In a further 50 per cent., while the patient may remain well in the interval, a subsequent pregnancy is liable to be associated with marked albuminuria.

The prognosis for the foetus has already been referred to in connection with the liability to premature labour: in other cases the prospects of the foetus are impaired by the necessity for the induction of premature labour in the interests of the mother. At full term, in cases of persisting albuminuria, the foetus may be ill-nourished or even macerated.

TREATMENT.—The essential point in the treatment of these cases is early diagnosis. The urine of every pregnant woman should be examined at least once a month up to the seventh month: once a fortnight in the seventh and eighth months, and then weekly until the birth. Of equal, if not greater, importance is the regular estimation of the blood-pressure—as has been pointed out (p. 190) a raised blood-pressure may precede albuminuria by several weeks. The routine weighing of the patient from the time she first comes under observation during her pregnancy may give the very earliest sign of the tendency to abnormal water retention (p. 190). When an increase of weight of over 5 lbs. a month, or a raised blood-pressure is found, the patient should at once be put under treatment as a case of early toxæmia. Further, all antenatal patients should be instructed to report to their medical attendant on noticing any surface œdema, or when disturbed by headaches or eye symptoms, so that no opportunity of early diagnosis should be lost.

When elevated blood-pressure, abnormal increase in weight, or surface œdema is noted in a pregnant woman, the urine should be carefully examined for albumin. *If there is even a haze present* a catheter specimen should be taken direct into a sterile bottle, so that the test for albumin may be made in a specimen free from the contamination of vaginal secretion. Further, the specimen so obtained is available for bacteriological examination—the importance of the early diagnosis of pyelitis is referred to in another section (p. 262). If even a trace of albumin is found, or if there is a raised blood-pressure, abnormal increase in weight, or œdema, without albuminuria, the patient should be put on to a restricted diet with a fairly low protein content, a reduced salt content, and large amounts of fluid. The volume of urine must be noted daily to prevent undue retention of fluid in the tissues. She should be instructed to take regularly a mild saline aperient of the *mist-alba* type.

Where there is more marked albuminuria the patient should be kept in bed and for the first twenty-four or forty-eight hours given only fluids containing glucose, to allow a more accurate assessment of her

condition. The amount of urine excreted, the amount of albumin in the urine, the blood urea and the urea concentration should all be tested: the blood-pressure should be taken several times during this period, as the first readings may be unreliable because of the patient's excitement. The bowel should be well cleared in the first instance by a hydragogue purgative, such as compound jalap powder, and then kept moving freely by a mild saline aperient, such as *mist-alba*. The skin should be encouraged to act freely by dressing the patient in flannel, keeping her between blankets, and using hot-water bottles freely. Large quantities of fluid should be given—not less than 4 or 5 pints in twenty-four hours: it may sometimes be difficult to get the patient to take quite as much, and the amount should be reduced if there is extreme œdema. It is doubtful whether a diuretic mixture will help at this stage, but in cases of extreme œdema large amounts of alkalis per day (250 or even 500 grains in twenty-four hours) appear to promote excretion. After the first twenty-four or forty-eight hours the patient should be put on to a restricted diet with a low protein content and abundant carbohydrate: if the protein content is too low the patient will have to use her own tissues to supply nitrogen to the fœtus, and the kidneys will continue to excrete nitrogen. At this stage milk is not a very suitable form of nourishment, owing to its high protein content: fresh fruits and salads are most useful. Iron should be given, either as Bland's pills or one of the scale preparations, to prevent anæmia. Such close and accurate supervision is so necessary in this type of case that it is essential that the patient should be nursed in hospital or under equivalent conditions. One most important principle in treatment is complete rest—particularly valuable in the control of hypertension. While the measures described above usually secure an adequate diuresis, it is almost impossible to get the urine completely free from albumin before the end of pregnancy.

The ætiology of this type of albuminuria is so closely associated with that of eclampsia that it is not discussed separately here. However, in virtue of various theories about the cause of eclampsia, other therapeutic measures have been advised. Relatively large doses of thyroid extract, up to 5 or 6 grains, have been given: more recently the ovarian hormones, especially that of the corpus luteum, have been recommended. The use of large amounts of alkali, especially in cases with great œdema, has been referred to. Much attention has been directed recently to the importance of calcium therapy: it has been prescribed alone, with alkalis or with the vitamins A and D, not only as a routine prophylactic measure, but also for the relief of established albuminuria. On the analogy of the prevention or treatment of experimental liver destruction in animals, calcium in the form of gluconate salt with glucose has been recommended for intravenous administration. Again, good results have been described from the use of ultra-violet radiation.

Further treatment depends on the patient's response. Improvement is shown by a fall in the blood-pressure and in the amount of albumin, by an increase in the amount of urine secreted, and by the disappearance of œdema. A rapid improvement will warrant a more liberal diet, but when this albuminuric tendency has manifested itself, the patient must be kept under the closest supervision throughout the rest of her pregnancy. She should be examined at not less than weekly intervals, the blood-pressure, the amount of urine passed, the quantity of albumin and the presence or absence of œdema being recorded.

When the amount of albumin falls below two parts Esbach but does not disappear completely, even though the systolic blood-pressure falls below 140, the patient must be kept in bed under observation on a restricted diet. If the albuminuria persists beyond two weeks, the possibility of permanent kidney damage, which may show itself either as a persisting chronic nephritis or a recurrent severe albuminuria in subsequent pregnancies or of persistent hypertension, must be considered. The soundest treatment under those circumstances is to terminate the pregnancy—the most satisfactory method for this purpose is simple puncture of the membranes: the patient usually goes into labour very promptly (p. 734). Such a policy gives little consideration to the welfare of the child, but it has already been indicated that the prognosis for the foetus is not good in this condition.

When the albuminuria not only fails to disappear, but even under such careful régime remains progressive, with a rise in blood-pressure, reduced urinary excretion, an increase in the amount of albumin, especially with a fall in the urea content of the urine, and more definite subjective symptoms, such as severe headache, eye symptoms, nausea and vomiting with epigastric pain, the patient must be regarded as dangerously ill, with an eclamptic seizure just imminent. The measures described in the next section for preventing the occurrence of eclamptic seizures should be instituted at once, morphia and chloral administered, and labour induced by the puncture of the membranes. Should the condition of the patient indicate extreme urgency, or should there be any obstetric abnormality likely to cause a prolonged or difficult labour, emptying of the uterus by Cæsarean section would be well justified, especially in a primigravida. The anaesthesia requires special care—nitrous oxide with oxygen is unquestionably the most satisfactory method.

Chronic Nephritis associated with Pregnancy.—In all cases of chronic nephritis the occurrence of pregnancy is a serious complication—in few cases is compensation so well maintained that both mother and foetus escape without damage. The kidney may just have been able to cope with the excretory processes of the non-pregnant state; then, with the progress of pregnancy, renal inefficiency appears in the early or late months, according to the severity of the renal lesion.

It is almost impossible to differentiate the various types of chronic nephritis when they are associated with pregnancy; the distinctive features of each are obscured by the added complication. This failure in function may be due to the mere mechanical strain of the extra services required during pregnancy, but more likely to a toxic disturbance, the circulating toxins, referred to elsewhere (p. 211), acting on the already damaged renal epithelium.

The decision in individual cases as to whether an albuminuria is due to chronic nephritis or to pre-eclampsia may be very difficult. The clinical history may not reveal any previous illness, such as scarlet or rheumatic fever, likely to have given rise to chronic renal impairment, or, even with such a history, any evidence that the kidney had sustained permanent damage. Yet the early development and persistence of albuminuria and hypertension during and after the pregnancy may suggest that there was some previous organic renal damage made worse by the course of pregnancy. Particularly difficult are those cases in which successive pregnancies are complicated by albuminuria of mild degree, without there being any evidence of chronic nephritis in the intervals (p. 210). Even the methods of the clinical laboratory may not give a clear differentiation. The frequency of chronic nephritis among the various conditions giving rise to albuminuria and hypertension during pregnancy has been estimated at from 10 to 25 per cent., this wide range being due to the difficulty of obtaining exact criteria on which to base an absolute differential diagnosis.

Clinical Course.—The clinical course of pregnancy complicated by chronic nephritis is very like that found in pre-eclampsia, the onset of symptoms, however, occurring at any stage of pregnancy, whereas pre-eclampsia does not usually appear until the last three months. Where the renal lesion is severe, symptoms may appear as early as the third month. The patient complains of lassitude, malaise, headache and œdema, which may develop into a general anasarca. The legs usually show œdema first; the face, especially the eyelids and the conjunctivæ, follow early; the vulva may become converted into an almost translucent tumour, and fluid may appear in the pleural or peritoneal cavities. The patient has a pasty look; there is the typical appearance of severe anæmia. Sickness is frequent.

The blood-pressure is usually high—the systolic pressure frequently over 200 and the diastolic pressure up to 120 or 140. Occasionally the blood-pressure remains at lower figures, though well above the normal, and in such cases the differential diagnosis from pre-eclampsia is particularly difficult. Albuminuria is almost always present, sometimes in very large amount, especially near the time of delivery. There may be a very copious excretion of urine of low specific gravity: the urinary output may become scanty and this probably results from the establishment of new degenerative changes in the renal epithelium

by the added toxæmia. The most characteristic lesion is visual disturbance, which is found to be associated with an albuminuric retinitis. This condition, however, may be found in severe cases of pre-eclamptic toxæmia, but arterio-sclerotic changes in the retinal arteries are diagnostic of chronic nephritis (p. 212). In many cases the pregnancy continues to term or to a premature labour: occasionally an exacerbation occurs and uræmia develops: accidental hæmorrhage, particularly the concealed type, may occur, or the patient may develop all the symptoms of the immediate pre-eclamptic state and pass on to actual convulsions. After delivery it is characteristic of this condition that the renal lesion remains very conspicuous, in contrast to the rapid recovery usually found after pre-eclampsia or eclampsia. The albuminuria and hypertension remain, and where the lesion was known to be present before pregnancy, the patient's condition is definitely worse after it.

Examination of the urine shows little that is characteristic. A great variety of casts can be identified in the sediment. The coagulum contains less globulin than in pre-eclampsia—one-sixth against one-third (p. 212). The blood shows an increase in the non-protein nitrogen, associated with urea retention, and may rise from 20 mg. per cent. up to 40 or 45. The carbon-dioxide combining power is normal. The sodium chloride content of the blood is usually high. Among renal functional tests, the most helpful is the urea concentration test, which shows in such cases that the concentrating power is markedly diminished.

Prognosis.—Chronic nephritis has an unfavourable influence on pregnancy. There may be abortion, miscarriage or premature labour. Next to syphilis, it is the most frequent cause of death of the ovum—the ovum death-rate in such cases has been estimated at over 40 per cent. In the later months accidental hæmorrhage may be a dangerous complication. The course of labour is slow; the activity of the uterine muscles seems impaired. Œdema of the vulva increases the liability to tearing. The atonic uterus favours the occurrence of postpartum hæmorrhage; the process of involution is slow, and the patient shows poor resistance to puerperal infection.

Occasionally a macerated fœtus is born near full time; more often the child is under-developed and poorly nourished. Such children, however, often show much better progress than a premature child of equal weight. When the placenta is examined, it is found to contain white or red infarctions, and so much of its functional tissue may have been destroyed as to give a ready explanation for the poor development and nourishment of the fœtus (p. 311).

For the mother the immediate prognosis may be fairly good, apart from the risk of uræmia, eclampsia or accidental hæmorrhage. On the other hand, the ultimate prognosis is bad. Succeeding pregnancies are likely to be associated with more severe and earlier disturbance, and

the degree of permanent renal damage is increased with each. The albuminuric retinitis may advance to such a degree as to cause total blindness. The prognosis in the current pregnancy is specially grave where the renal lesion is associated with cardiac disability.

Differential Diagnosis.—The most important object in diagnosis is to distinguish chronic nephritis complicating pregnancy from pre-eclampsia. Reference has already been made as to how difficult this may be. The most important points in recognising the chronic nephritic type are (1) the clinical history of preceding nephritis, or of illnesses likely to be associated with chronic renal impairment; (2) the presence of characteristic lesions in the maternal cardiovascular system, hypertrophy of the heart and thickening of the vessels, usually found in chronic nephritis; (3) the appearance of albuminuria, hypertension and oedema in the earlier months of pregnancy; (4) the presence of arterio-sclerosis in the retinal vessels, one of the most distinctive features in differential diagnosis; (5) clear evidence of nitrogen retention in the blood and of poor urea concentration; (6) the persistence of the symptoms after labour—where hypertension and albuminuria persist for over ten days after labour, the existence of a permanent renal lesion is almost certain.

It is also necessary to differentiate cases of chronic pyelitis. The pyelitis may not be associated with fever, but there is a persistent pyuria giving a positive reaction for albumin. The blood-pressure in uncomplicated pyelitis is seldom raised.

Treatment.—Cases of this type are investigated and treated on exactly the same lines as have been described for the toxic albuminurias of pregnancy (p. 216). When symptoms appear early, and do not respond quickly to conservative treatment, there is a clear indication for terminating the pregnancy in the interests of the mother. The presence of progressive albuminuric retinitis at any stage of pregnancy should be regarded as an urgent reason for terminating the pregnancy, because of the risk of total blindness. It is evident from the description of the prognosis for the mother that not only may the termination of the current pregnancy be advisable, where the symptoms are severe, but that the danger in later pregnancies may be so great as to warrant sterilisation of the patient.

Essential Hypertension associated with Pregnancy.—The routine examination of pregnant women has revealed the fact that in many the blood-pressure is already raised in the early months. The clinical picture in the later months so closely resembles that found in cases of chronic nephritis that many of the cases are diagnosed as *chronic nephritis*. There are seldom any associated subjective symptoms in the early months, and it may be difficult to identify in the clinical history any illness likely to have been followed by hypertension, other than a previous pregnancy complicated by albuminuria. The systolic blood-pressure in the early months is usually already raised to 140

or 160, which may later rise to 180 or 200, with a diastolic pressure of 100 or 120. This hypertension does not respond to treatment by rest, as it usually does in the pre-eclamptic type. The urine shows only a small amount of albumin—in some cases, in spite of the high blood-pressure, the urine may remain free from albumin throughout the pregnancy.

In the later months there may be an impairment of renal function, with an increase in the amount of albumin in the urine. The urea concentration test which had given normal readings, will now indicate impairment of function. The eyes may show albuminuric retinitis and arterio-sclerotic changes in the retinal arteries. In the more severe cases there is a tendency to uræmia, accidental hæmorrhage, cerebral hæmorrhage and sometimes eclampsia. This type of case is treated on the principles which have already been described for pre-eclamptic toxæmia and chronic nephritis. Where the hypertension resists treatment it is perhaps less urgent to terminate the pregnancy in the mother's interests than in even chronic nephritis: there is already an established lesion which is not going to be greatly influenced by the continuance of this pregnancy. Where signs of marked renal insufficiency appear, the pregnancy should be terminated in the immediate interest of the patient. The type of lesion found in the kidney shows an essential arterio-sclerosis affecting the afferent vessels of the glomeruli, going on to occlusion of the vessels and eventually nephro-sclerosis. These changes are the local manifestations of a generalised sclerosis.

The accurate investigation of patients who have shown persistent albuminuria in a previous pregnancy, and who have a recurrence in later pregnancies, suggests that in 60 or 70 per cent. of those patients there is a persistent hypertension rather than a true chronic nephritis.

ECLAMPSIA

Eclampsia is an acute toxæmia occurring in women in association with pregnancy, and is usually accompanied by tonic and clonic convulsions, during which there is loss of consciousness, followed by coma. Some cases show at autopsy the typical lesions of eclampsia where death has occurred in coma without convulsions having ever appeared. The absolute test of eclampsia is the hepatic lesion found at autopsy.

INCIDENCE.—The incidence of eclampsia has been variously estimated at from 1 in 500 to 1 in 800 pregnancies. This variation is due to the fact that the incidence varies in districts and climates: in Edinburgh and Glasgow, eclampsia is not only more frequent, but also appears to be of a more severe type than in London. It appears to be less frequent in warm climates and among people whose diet is largely vegetable in character. The fact that eclamptic cases are usually admitted to maternity hospitals in varying frequency through-

out the year has led to many attempts to correlate the incidence with variations in temperature and humidity: the cold damp weather of the spring appears to be associated with the greatest frequency. Eclampsia appears typically after the twenty-eighth week, though cases have been recorded as early as the tenth week. About 70 per cent. of the patients are primigravidæ and it has been found that the incidence is about four or five times greater when the uterus is over-distended, as in plural pregnancy or hydramnios; severe cases of eclampsia have occurred in cases of hydatidiform mole and in advanced extra-uterine pregnancy. About 20 per cent. of the cases occur in the puerperium, though when convulsions occur more than forty-eight



FIG. 83.—Liver in Eclampsia. The typical peri-portal eclamptic lesion is seen on the left. The remainder of the liver is intact, including the cells around the central vein on the right. (H. L. Sheehan.)

hours after the completion of labour, the cause is rarely eclampsia. There is some variation in the estimation of the frequency of eclampsia during pregnancy and labour, due to the fact that premature labour usually occurs when eclampsia occurs before full time. Taking the incidence of puerperal eclampsia as 20 per cent., the antepartum incidence is about 50 per cent. and the intrapartum about 30 per cent.

PATHOLOGY.—*Liver.*—Some of the most characteristic lesions of eclampsia are seen in the liver. The essential changes were described by Jurgens in 1886, and by Pilliet in 1891. Externally the liver shows numerous small petechial hæmorrhages under the capsule: sometimes these are very extensive and may become confluent. On section tiny petechial hæmorrhages may be seen, but they are usually too small to be recognised by the naked eye; occasionally small pale necrotic areas can be recognised.

Microscopically, the lesion is found to be near the portal tracts. Here there are masses of blood-filled spaces with the appearance of a bunch of distended capillaries. Frequently there is much fibrin deposited in this area, and in older lesions there are accumulations of polymorphs. Rarely, and apparently as secondary phenomena, there may be true infarction of small areas of liver tissue, or necrosis of the centres of lobules; very occasionally there is thrombosis of vessels in the portal tract (Fig. 83).

These periportal lesions occur only in eclampsia and allied conditions, and are present in almost every case. They are so characteristic

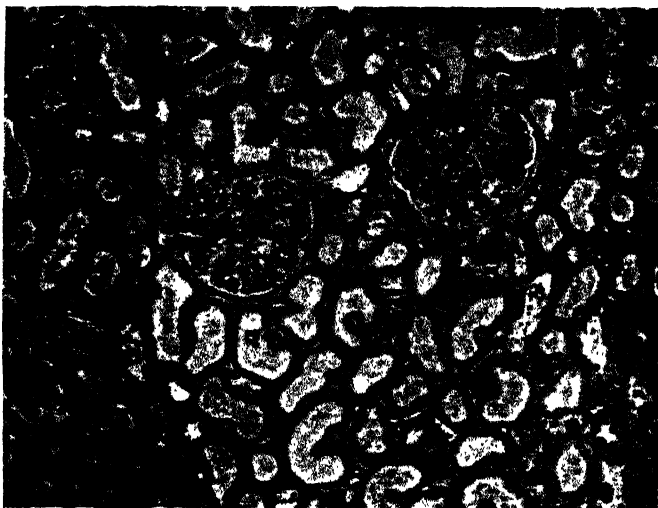


FIG. 84.—Kidney in Eclampsia. This shows the typical appearance of eclamptic glomeruli with ordinary staining; special stains are required for identification of the finer changes. The convoluted tubules are lined by low but healthy epithelium, and their lumen is filled with albuminous urine. (H. L. Sheehan)

that in a case in which those lesions are found, even though there have been no convulsions, the condition is diagnosed as "eclampsia without convulsions." The lesions show little or no relationship to the clinical severity of the disease; a patient who has had only one or two fits may show very gross liver lesions, whereas a patient who has had twenty or thirty fits may have lesions so scanty that they can only be found after prolonged microscopic search.

Though numerous hypotheses have been put forward, no satisfactory explanation can be given for the occurrence of the lesion. Experimentally it is possible to produce changes rather similar in type by intravenous injection of tissue fibrinogen, or by cytotoxic sera, but the connection between these and the lesions of human eclampsia is not at all clear.

The Kidneys.—The kidneys are slightly enlarged and rather pale.

On section, the cortex is, in most cases, rather pale and broader than normal, but it may show no abnormality. The medulla is rather congested. Apart from the exceptional cases of cortical necrosis (p. 237), there are no hæmorrhages or necroses.

Microscopically there are very characteristic changes in the glomeruli (Fig. 84). The essential lesion is thickening of the basement membrane of the glomerular capillaries, with a swelling of the endothelial cytoplasm, causing together an encroachment upon the capillary lumen. These changes require a special histological technique for their demonstration, but they are quite specific for eclampsia and pre-eclampsia, and even more constant than the liver lesion. This narrowing of the lumina of the capillaries interferes with the circulation of blood through the glomerular loops. In such cases hæmoglobin casts are present in some of the tubules. The degenerative changes which have been described in the convoluted tubules are probably artefacts, due to post-mortem autolysis. The ætiology of these renal changes has not yet been elucidated, but there is no evidence to suggest the direct action of any toxin.

Brain.—In a certain number of cases of eclampsia there are intracranial hæmorrhages. The more common lesions are true cerebral apoplexies—sometimes small, sometimes large—and extending into the ventricles. Pontine hæmorrhages are sometimes found and may be associated with hyperpyrexia. In other cases there are hæmorrhages into the *pia-arachnoid* over the surface of the cerebral hemispheres. Areas of softening have also been described.

The special feature of these lesions is their occurrence in women at such an early age. There is no relationship to the number of convulsions, and the hæmorrhages appear to be due to the vascular disturbance itself. They are very difficult to diagnose during life—coma and symptoms of hemiplegia may be present in eclamptic patients without there being any cerebral lesion.

Lungs.—The lungs always show œdema and congestion, and on microscopic examination there is usually a very early bronchopneumonia. These changes are probably vascular in origin.

Other Organs.—The heart sometimes shows slight hypertrophy of the left ventricle. Degenerative lesions of the myocardium and necrotic or hæmorrhagic lesions of the spleen were recorded frequently in the older literature, but these do not seem to be in any way characteristic of eclampsia. The ureters frequently show dilatation, but this is usual in pregnancy (p. 262) and does not appear to have any relationship to eclampsia. Sometimes small hæmorrhages are found in the viscera of the foetus, but these do not resemble eclamptic lesions and are found in many other conditions.

PATHOLOGICAL CHEMISTRY.—The urine during the eclamptic seizures is invariably reduced in amount, even less than 100 c.c. in twenty-four hours; it may be entirely suppressed. Blood is almost always present,

and casts of all types, more commonly hyaline and granular, but also epithelial, may be present. Isolated renal cells may be found. There may be an actual hæmoglobinuria.

Albumin is present in large amount, and, owing to the presence of globulin, the precipitate formed on boiling is usually quite solid. Dilution may be necessary to obtain a reading on the Esbach albuminometer. The albumin present varies from 10 to 30 or 40 grams per litre. Where separation of globulin and albumin has been carried out, it has been found that globulin constitutes 33 per cent. of the whole. This is an important variation from chronic nephritis, where globulin forms only 15 per cent. of the whole.

This high albumin-content is only temporary. It falls very rapidly as recovery takes place, and within forty-eight hours may be only 1 gram per litre. It usually disappears completely within a few weeks, and the kidneys seem to recover their function completely. It is very important to note what an enormous amount of albumin may be present in the urine without the kidneys suffering any permanent damage.

The total nitrogen excreted per twenty-four hours is very much diminished, as might be expected from the small amount of urine passed. The urea excretion is reduced, the urea nitrogen forming about 65 instead of 80 per cent. The ammonia coefficient falls with the onset of convulsions, but rises immediately afterwards, and remains at a high level in favourable cases. The amount of amino-acids is increased, and the remaining nitrogenous constituents, uric acid, creatinine and undetermined nitrogen, are increased. The chlorides in the urine are diminished, but rise to a very high level at the beginning of convalescence. Acetone and diacetic acid are usually present.

After the attack, the quantity of urine is usually increased for about forty-eight hours. The amount passed may be as much as 2000 or 2500 c.c. in twenty-four hours.

As the patient recovers, the urine returns to a normal condition. There is at first a great increase in the total nitrogen, but we must remember that a great increase occurs in this factor in a normal puerperium, in part owing to the excretion of the products of the involution of the uterus. The albuminuria clears up rapidly: if it does not do so, we must assume permanent damage to renal tissue, which was either present before the eclamptic attack or has resulted from it.

The variations in the blood in eclampsia have been carefully studied. The blood urea is within normal limits. The most striking feature is an increase in the amount of uric acid, which has been found to be specially high in cases which eventually proved fatal. The carbon-dioxide combining power of the blood is diminished in association with the tendency to acidosis; the blood-sugar is usually increased, and there is also a rise in the lactic acid content. The blood chlorides are increased,

particularly in cases with marked oedema. There is an elevation of the phosphorus-calcium ratio, due to a decrease in the latter rather than an increase in the former. The hydrogen-ion concentration falls to 7, indicating a true acidosis. After the eclamptic attack, the non-protein nitrogen of the blood undergoes a sudden rise, and then returns slowly to normal.

Recent work shows that there is a marked concentration of the blood during the few days before eclampsia develops. After delivery there is a great dilution of the blood for a few days, and then a gradual recovery to normal. Changes in the blood lipoids have also been found: cases with eclamptic convulsions have a very high ratio of phospho-lipoid to cholesterol.

ÆTIOLOGY.—The multiplicity of views regarding the cause of eclampsia has been referred to on page 198. The disease was known in the time of Hippocrates. Until last century it was believed to be a disturbance of the nervous system—the most prominent symptom was the convulsive seizures. Lever's discovery of the associated albuminuria brought the disease into the category of renal lesions, where it remained for about forty years. For the past fifty years, this disease has been intensively studied in the clinic and in the laboratory, with series of statistical surveys and animal experiments, but without any certain conclusion as to its origin being arrived at. A number of general clinical observations have been made and inferences drawn. There appears to be a slight seasonal variation—cases seem most liable to occur in cold, damp weather. During the Great War the incidence of eclampsia in Central Europe fell very markedly, and this is believed to have been due to the food restrictions resulting from the blockade. The fall was most evident in large cities, where the food shortage was most marked. Eclampsia is rare in warm climates, but there is the additional factor that the diet in such regions usually consists almost entirely of cereals.

Among the theories of the cause of eclampsia, the influence of diet still remains under discussion, but in the sense that a deficiency in the calcium content and in the vitamins A and D, specially associated with the metabolism of calcium, may be an important factor. When the diet of pregnant women is deficient in those elements, the incidence of pre-eclamptic toxæmia has been found to be increased. This does not really conflict with the reduction in the incidence of eclampsia in certain areas during the Great War, because food shortage required a greater use of cereals and vegetables, which have a larger calcium and vitamin content than meat. Analysis of the blood in cases of eclamptic toxæmia does not appear to give direct support to this theory, as the calcium content of the serum remains normal: the variation may take place only in the ionised calcium.

Many efforts have been made to identify some disturbance of endocrine function as an ætiological factor. The old view that the

albuminuria of pregnancy was due to a thyroid deficiency has not been confirmed. While the parathyroid glands may control calcium metabolism, and a deficiency in their secretion may cause the development of tetany in pregnant women (p. 272), no relationship has yet been established between the function of those glands and eclampsia. Recently it has been suggested that hypersecretion by the posterior lobe of the pituitary gland of pressor and antidiuretic hormones might cause the hypertension and œdema of pregnant women, but scientific confirmation of this idea is still lacking. No close association has yet been found between the functions of the remaining endocrine glands and eclampsia.

Certain changes in function have been observed during pregnancy which appear to be important in the development of eclampsia, though the ultimate causes of those changes have not been identified. Convulsions can be produced in animals by the application of powdered creatinine to the cerebral cortex, and it has been found that much smaller amounts of creatinine produce this reaction in pregnant than in non-pregnant animals.

Observation of the capillary circulation at the base of the finger nails with the capillary microscope shows in pre-eclamptic and eclamptic patients recurring spasmodic contractions of the capillaries, occasionally causing complete cessation and even reversal of the current. The importance of this angiospasm in the development of some of the symptoms and lesions in eclampsia can be readily appreciated, and the prevention of angiospasm must be considered in treatment.

The third important change is the tendency of the tissues in pre-eclamptic patients to fluid retention. This may be due to increased permeability of the capillaries, and a rise in blood-pressure would be necessary to overcome the increased peripheral resistance thus produced. Accumulation of fluid in the cerebral tissues would give rise to headache, disturbance of vision and eventually convulsions. Albuminuria would result from œdema of the secreting renal cells. On the other hand, the fluid retention may be due to a lowering of the osmotic pressure of the blood plasma proteins, associated with increased venous pressure. While the increased venous pressure may be due to the mechanical effect of the enlarging uterus acting against the taut abdominal wall, the change in the plasma proteins may be the result of the extreme reduction of the protein content of the diet, which has until now played such an important part in the treatment of pre-eclamptic toxæmia (p. 215). This fluid retention appears to be of less importance than angiospasm, in that some of the most serious cases of eclampsia show no œdema.

The conventional attitude towards the ætiology of eclampsia for the past fifty years has been to assume the production of a toxin acting on the kidneys and the liver, and having a special affinity for the

cortex of the fore-brain, as shown by the constancy of convulsions and coma. Years of research have failed to identify a specific toxin, but recent work suggests that it is essentially of an allergic nature.

CLINICAL HISTORY.—Three distinct types of eclampsia are known : (1) the fulminating type ; (2) the slow type developing gradually from a pre-eclamptic toxæmia ; (3) the type in which coma develops without convulsions.

In the first or *fulminating* type the first indication of the disease may be the actual eclamptic fit. In many cases of this type, however, there is a brief premonitory disturbance, such as sudden blindness. In the second type there are definite warning symptoms of an acute attack. The symptoms of pre-eclamptic toxæmia become more pronounced (p. 217), though, in a few cases, there may be an actual alleviation of the subjective symptoms just before the seizure. Headache becomes more severe and constant. The patient complains of flashes of light before her eyes ; the eyelids appear puffy. Hemianopsia, diplopia or complete amaurosis may occur, associated, on ophthalmoscopic examination, with œdema only, or sometimes with partial separation of the retina. There is severe epigastric pain and often vomiting. Œdema of the legs, and occasionally of the vulva, becomes increased. The urine is very scanty or suppressed ; the other changes in the urine have been described. The systolic blood-pressure rises to 200 or 240. The patient becomes very restless, especially before the onset of the convulsions. In the third type there may be a history of headaches and other discomforts, ending in coma and death without any convulsion having occurred. At autopsy the organs show the characteristic lesions of eclampsia, and the condition is described as *eclampsia without convulsions*.

THE ECLAMPTIC SEIZURE.—The actual eclamptic attack may be divided into several stages : (1) *Premonitory Stage*. The attack may occur even in the patient's sleep. If she is going about, she falls to the ground unconscious. She rolls her eyes, the head may be drawn to one side, and there may be twitchings of the hands and face. This stage lasts for about twenty seconds and passes immediately into (2) *The Tonic Stage*. The patient becomes rigid owing to the spread of the muscular contraction. The features are distorted, hands clenched, feet inverted and the toes flexed. The whole body is gripped in a tonic spasm. This may last for thirty seconds, and is followed by (3) *The Clonic Stage*. The muscles are now spasmodically contracted and then relaxed. The jaws open and close, and the teeth may injure the tongue severely if proper precautions are not taken. The blood-stained saliva is beaten up to a froth. The face is congested ; the eyes protrude, and the breathing is stertorous. The patient is deeply unconscious. The violence of the movements may throw the patient out of bed. This stage lasts from one to two minutes and passes into (4) *The Stage of Coma*. This coma

may continue for several hours. Stertorous breathing continues, but gradually the respirations quieten down. The patient eventually wakes up to consciousness, or the coma is interrupted by another fit. The temperature may rise during the attack to 104° or 105° , and the blood-pressure may register 250. The pulse is full and bounding. The high temperature is due either to an interference with the heat centre in the medulla, or to excessive heat production, resulting from muscular activity. The blood-pressure falls after the attack.

Recurrence of Fits.—The convulsion may recur while the patient is still comatose, or there may be a brief spell of consciousness. While there is often an interval of some twenty or thirty minutes between the fits, they may succeed each other very rapidly—a very serious prognostic sign. As the fits recur, the interval between them becomes shortened. Occasionally, especially at the end of labour or in the puerperium, there may be only a single convulsion.

THE EFFECT OF ECLAMPSIA ON PREGNANCY.—In the *antepartum* variety of eclampsia, the seizures are usually followed by the onset of labour. Should there be indications that the mother may die undelivered, Cæsarean section should be performed in the hope of saving the child. Where recovery occurs without the onset of labour, the mother may give birth to a live child at term, or she may expel a dead foetus before term. Occasionally albumin is found in the urine of the child and it may develop mild convulsions.

In the *intrapartum* variety the labour pains are usually increased in violence and the child is born more quickly. The birth of the child often terminates the convulsions.

In the *postpartum* variety there may be only a single convulsion. However, postpartum eclampsia is still to be regarded as a severe disease, the mortality rate being almost as high as in the antepartum type. Cases of eclampsia have been described as occurring several weeks after birth, but these are almost certainly due to chronic nephritis, developing into uræmia.

COMPLICATIONS FOLLOWING THE ECLAMPTIC SEIZURE.—The patient may injure her tongue severely during the fit. She may suffer contusions or even fractures from having been thrown out of bed by the violence of the convulsions. Where she is allowed to lie with her face upwards, she may suffocate during the fit or develop bronchopneumonia thereafter, owing to the inhalation of food or septic saliva. Concealed accidental hæmorrhage may occur, but rarely during or after convulsions. The most serious lesion, however, is cerebral hæmorrhage.

The coma following the fit may persist for several hours. When she wakes up, the patient may have no recollection of what happened immediately prior to the fit, or even from many hours before it. Actual mental derangement of the confusional type occurs in some patients, and may persist for several weeks (p. 256).

The secretion of urine may remain scanty or even become entirely suppressed. This latter complication has a very grave prognosis and is due to a definite pathological change in the kidney, described later as *bilateral cortical necrosis* (p. 237).

Sometimes jaundice occurs during the course of the disease, and indicates serious hepatic involvement.

The eye symptoms characteristic of this disease usually disappear completely, except where they happen to be associated with a permanent lesion in the optic tract or optic centre in the brain.

DIAGNOSIS.—The diagnosis of the acute stage of eclampsia offers little difficulty. With epileptic convulsions there is the history of epilepsy. Difficulty, however, may arise when coma develops without convulsions, for the coma may be due to an overlooked diabetes or a cerebral hæmorrhage.

PROGNOSIS.—The prognosis is always serious, as the maternal mortality varies from 10 to 25 per cent. The intrapartum cases are less dangerous than the antepartum or postpartum varieties. The prognosis becomes more serious the more often the fits recur and the shorter the interval between the fits. Over 200 seizures may take place in one case: in such a case, described by Jardine, recovery followed. When the coma is deep and prolonged, the outlook is grave. When the urine remains scanty or suppressed and the albumin-content high, the prognosis is bad. A persistent high blood-pressure, and a weak, rapid, thready pulse are also bad signs. Almost paradoxically, some very severe cases of eclampsia have a low blood-pressure—it may never rise above 140. Some severe cases, too, show no trace of œdema, and in our experience pronounced œdema is not an unfavourable sign. The higher the temperature, the less favourable the case. The occurrence of jaundice is a serious prognostic sign. Some types of eclampsia, local and seasonal, are more severe than others. Most important of all is the response to treatment. When the skin can be made to perspire profusely, the kidneys to secrete well and the pulse to fall in rate and in tension, the prognosis is good.

The prognosis in subsequent pregnancies is of great importance, in view of the fact that eclampsia occurs so much more frequently in first than in later pregnancies. An actual recurrence of eclampsia is infrequent—not more than 4 per cent., but about 25 per cent. of the patients develop essential hypertension or chronic nephritis, with all the dangers to which women with those conditions are liable during pregnancy (pp. 210 and 216). Eclamptic patients require to be kept under observation for at least six months after the attack, before this prognosis can be accurately assessed. Women who seem to have made a very good immediate recovery, as judged by the rapid disappearance of albumin from the urine and the fall of the blood-pressure to normal, may be found a few months later to show clear evidence of permanent cardio-vascular or renal damage, whereas a

woman who appeared to be making an unsatisfactory recovery may be found a few months later to show no trace of permanent damage.

The prognosis for the child is bad, as 50 per cent. of the children are born dead, or die soon after delivery. In many cases prematurity may be the cause of death, as labour occurs so frequently before term. Occasionally the child develops convulsions.

THE CAUSE OF DEATH IN ECLAMPSIA.—The mother may die from asphyxia due to cessation of respiration during the convulsion, or to the entrance of saliva or vomitus into the larynx during the fit or the subsequent coma. She may die from pulmonary œdema. Cerebral hæmorrhage is a frequent cause of death, but the most frequent appears to be cardiac failure, associated with degenerative changes in cardiac muscle, resulting from hypertension, widespread œdema and rapidly recurring convulsions. The patient may die later from an embolic lesion, or from a septic broncho-pneumonia, following the inhalation of fluid or solid material during a convulsion. Late deaths may occur from sepsis, to which eclamptic patients appear to be relatively more susceptible.

TREATMENT.—The treatment of eclampsia has been handicapped, like that of *hyperemesis gravidarum*, by uncertainty as to the exact cause of the disease. Until fifty years ago the patients were treated first by the remedies applicable to such conditions as epilepsy, and then by those appropriate to nephritis. The methods were certainly conservative, and the only available statistics, those from a series of cases treated as nephritis, show a maternal mortality of 33 per cent.

What may be described as the radical method of treatment arose from the conception of eclampsia as a form of toxæmia, due to the presence of the ovum. This idea coincided with the period of rapid development in abdominal surgery, and it appeared sound treatment to get rid of the source of the toxæmia as quickly as possible, namely, by performing Cæsarean section. The operation was carried out after the first fit, and this policy appeared a great improvement, as the maternal mortality rate fell to 18 per cent. Some doubt was expressed as to whether an abdominal operation was justified, so there was developed the operation of vaginal Cæsarean section. Carried out near full time, especially in primigravidæ, this operation was associated with a good deal of trauma of the lower birth canal, but it was very much preferable to another form of treatment, designed for the same purpose, viz., accouchement forcé (p. 741). Here the cervix was forcibly dilated with a pronged metal dilator, the prongs being separated by a powerful screw mechanism. The degree of trauma was considerable; fistulæ into bladder and bowel were not infrequent. How unsatisfactory were these methods of treatment may be judged from the fact that in a series of 51 mild and 37 severe cases of eclampsia, treated by Cæsarean section, the maternal mortality rates were 9·8

and 43 per cent. In a series of 40 mild and 10 severe cases treated by *accouchement forcé*, the maternal mortality rates were 25 and 60 per cent.

Fortunately, there were still obstetricians who stuck to conservative measures. Stroganoff, working in Russia, was able in 1911 to publish a series of 600 cases treated by conservative methods, with a maternal mortality rate of only 8 per cent. The essential features of his treatment were complete isolation in a darkened room, keeping clear the respiratory passages, the administration of morphine hypodermically and of chloral per rectum, the administration of milk in small amounts up to 25 ounces per day, the same amount of saline per rectum or by the mouth, and the avoidance of all obstetric interference until the second stage of labour was well advanced. So essential did Stroganoff consider the avoidance of peripheral stimuli that all manipulations, even the giving of a hypodermic injection, were carried out under anaesthesia. Stroganoff's improved technique is described later (p. 232). Another exponent of the conservative school was Hastings Tweedy, who instituted what is now known as the Dublin method of treatment. The essential points in which this method differs from Stroganoff's are that great importance is attached to gastric and colonic lavage, the latter with very large enemata, and that there is no attempt at nutrition—only water is given. In his first series of 83 cases, Hastings Tweedy published a maternal mortality rate of just over 7 per cent.

The two methods differed so widely that eighteen years ago a committee of British obstetricians reviewed the methods of treatment and results in a series of 2000 cases of eclampsia within the British Isles. This review showed that when conservative methods, including spontaneous delivery, induction of labour and low-forceps operations, were employed, the maternal mortality for mild cases was only 5·4 per cent., and for severe cases 33·8 per cent. The results in the cases treated radically have already been quoted. For this review, a case was considered mild where the degree of albuminuria was moderate, the fits few and infrequent and the mental condition quite clear between the fits; cases were considered severe when the urine became solid on boiling, the fits more than ten in number and the coma continuous. In the series of 2000 cases, three-fifths were found to belong to the mild and two-fifths to the severe category. These results form a very strong plea for the conservative type of treatment.

In the review, the importance of prevention stood out very clearly. In 85 per cent. of the cases recorded there were obvious premonitory signs, and the earlier treatment of those patients might have prevented the actual occurrence of eclampsia. The prophylactic measures have already been described in detail (p. 190). To prevent eclampsia the antenatal supervision must conform to the standard described there. There are, unfortunately, occasional cases in which the first indication of the disease is the occurrence of an eclamptic convulsion

—the *fulminating* type of the disease, which includes some of the most severe cases.

In the treatment of actual eclampsia it is essential that the patient should be in hospital. Such cases are absolutely unsuitable for treatment at home, and should be transported to hospital immediately the first fit has occurred. It is desirable that $\frac{1}{4}$ grain of morphia should be administered hypodermically before transport. There must be continuous supervision, with sufficient nurses available to make sure that the patient is never left unobserved. The continuous assistance of a clinical laboratory is necessary, and expert medical supervision should always be available.

During the actual progress of a fit, great care should be taken to prevent the patient from injuring herself. The bed should be placed along the wall, so as to make it easier for the nurses to prevent the patient from falling out of bed during the violence of a convulsion. The clothing should always be loose. A gag (even an ordinary spoon handle with a handkerchief wrapped round it will suffice) should be placed between the teeth to prevent her from biting her tongue. The head should be held to one side to prevent the inhalation of saliva or vomitus. After each fit, and at regular intervals throughout the acute phase of the disease, the mouth and the upper respiratory tract should be carefully swabbed out, with a view to the prevention of a subsequent septic pneumonia. If the patient remains cyanosed at the end of the convulsion, oxygen should be administered. She should always be nursed in a room with an abundant supply of fresh air. There may be evidence of cardiac failure at the end of a convulsion, and cardiac stimulants may be required.

The further treatment aims at preventing the recurrence of fits by the use of sedative drugs, and securing elimination of the toxins accumulating in the body. In this field the results obtained by Stroganoff and by the adoption of his methods are so satisfactory that it is well to examine carefully the details of his technique and the principles upon which they are based. The essential points of his earlier technique have been referred to (p. 231), but he later introduced several modifications, such as the substitution of magnesium sulphate for chloral, no attempt at nutrition during the acute illness, the puncture of the membranes and more frequent venesection. With this improved technique he reported a series of 160 cases of eclampsia, treated under his own supervision, with a maternal mortality of only 2·5 per cent. and a foetal mortality of 18 per cent., which, by the exclusion of premature babies, might be reduced for statistical purposes to 8·5 per cent. In this series, 70 per cent. of the patients had no further convulsion after the first injection of magnesium sulphate: in all there were only 309 convulsions, of which 66 occurred before admission to hospital. He claimed that if his methods are accurately followed, the maternal mortality in eclampsia should be reduced to 0·5 per cent.,

and even with neglected cases and others with serious complications should not exceed 4 per cent.

The essential purpose of Stroganoff's method is to prevent the recurrence of convulsions. The convulsion is the greatest danger to the patient : it predisposes to paralysis of the respiratory and circulatory centres, to cerebral hæmorrhage, to pneumonia and to serious late results from sepsis or mental disturbance. Each convulsion produces an additional amount of toxin, the elimination of which becomes increasingly difficult.

Avoidance of Peripheral Stimuli.—The patient is nursed in absolute quietness in a darkened room. She is given sedatives to diminish sensitiveness to stimuli of all kinds. When interference is necessary, such as the administration of a hypodermic injection, catheterisation, the giving of an enema, venesection, the puncture of the membranes, an operative delivery or even a simple diagnostic vaginal examination, a general anæsthetic is given and for this purpose Stroganoff employed chloroform.

Application of Warmth.—Warmth produces dilatation of the peripheral vessels, reduces the tendency to angiospasm, facilitates the course of the circulation and the action of the heart, and by stimulating perspiration increases the elimination of toxins by the skin. Warmth applied to the lumbar region stimulates diuresis. Bedclothes should be warm but not heavy enough to impede respiration.

Narcotics and Analgesics.—Morphia is the least harmful narcotic for the mother : an idiosyncrasy to this drug is seldom met with. It has not been found to inhibit diuresis in eclamptic patients. Its unfavourable influence on the child (p. 621) can be dealt with by appropriate measures. The use of morphia reduces the amounts of other more toxic drugs necessary in treatment.

Chloral and chloroform diminish angiospasm and so render circulation and respiration more regular. They calm the patient and so help to prevent convulsions. Stroganoff claimed that chloroform is well borne and safe, as the duration of anæsthesia for the manipulations necessary in treatment is very short, and becomes less as the other drugs used in treatment take effect. It is preferable to ether in that the patient goes under more quickly, the following period of sleep is longer and the dilatation of the vessels greater, while there is not the excessive secretion from the respiratory tract produced by ether. Most obstetricians are opposed to the employment of chloroform.

The subcutaneous injection of magnesium sulphate relieves pain, though less than morphia, dilates the vessels, lowers arterial tension, helps to prevent convulsions, increases diuresis more than chloral, does not inhibit the course of labour and has no harmful effect on the fœtus. One of the disadvantages of this preparation is the tendency to suppuration at the seat of injection, found in about 1 per cent. of cases. Magnesium sulphate is more toxic than chloral, but should toxic

symptoms appear, an immediate relief can be secured by the intravenous injection of 10 grams of a 5 per cent. solution of calcium chloride. In view of this toxicity, Stroganoff occasionally replaces magnesium sulphate by veronal in the later stages of treatment.

Delivery of the Child.—A most important factor in the prevention of convulsions is the birth of the child. In a series of almost 2500 cases, 50 per cent. had no more fits after delivery. Where the fits continue, they are usually less severe and respond more readily to treatment. Where the labour can be terminated by a simple obstetric operation, such as *low forceps*, this should be carried out without delay under anæsthesia. Stroganoff is entirely opposed to Cæsarean section for this purpose: he believes that it not only does not improve the prognosis, but actually increases the risk of death. The operation should only be performed when there is some intercurrent obstetrical complication, such as a contracted pelvis.

Venesection.—When the patient has been admitted to hospital after six convulsions have occurred, or where, during treatment in hospital, three convulsions or even only two very severe convulsions have occurred, 400 to 600 c.c. of blood should be removed by venesection. This procedure relieves the heart, facilitates respiration and again relieves spasm of the vessels.

Puncture of the Membranes.—The diminution in the volume of the uterus by 100 to 400 c.c. following puncture of the membranes, lowers the intra-abdominal pressure. The blood flows more freely to the liver, the kidneys and the spleen. The diaphragm is lowered and respiration becomes easier, with a better supply of oxygen. The blood-pressure is slightly lowered. This operation has also an important function in hastening the evacuation of the uterine contents. Where the cervix was still undilated at the operation, Stroganoff found that the average interval until the delivery of the child was only twenty-five hours; where the cervix was already 2 cm. dilated, the average interval was eleven hours; where the dilatation was 3 cm., the interval was nine hours; where 4 cm. dilated, eight and a half hours; and where 5 cm. dilated, five and a half hours. In this series 89 per cent. of the patients were primigravidæ.

Posture.—The patient should be nursed on her right side, so as to facilitate the escape of saliva and mucous secretion. This position has been found to be associated with a lowering of blood-pressure of 10 to 12 mm. The patient should be changed temporarily on to her left side four or five times in twenty-four hours.

Nutrition.—The patient is not given nourishment and only a minimal amount of fluid during the acute phase of the illness.

Summary.—By such measures the elimination of toxins is secured by the freer action of the skin, the kidneys, the lungs and the intestines. The neutralisation of the toxins in the body is secured by improved respiration and the relief of angiospasm, allowing a better circulation

of oxygen. The prevention of the formation of new toxins is secured by the prevention of further fits, by the application of warmth, by sleep, by starvation during the acute phase, by the evacuation of the bowel and the delivery of the patient under general anæsthesia as soon as this can be safely carried out.

THE IMPROVED STROGANOFF TECHNIQUE.—The scheme of treatment recommended by Stroganoff is as follows :—

1. After the first convulsion, when respiration has been re-established, a subcutaneous injection of $\frac{1}{4}$ or $\frac{1}{3}$ grain of morphia is given. Should the first convulsion occur after the birth of the child, the amount of morphia may be reduced to $\frac{1}{8}$ or $\frac{1}{4}$ grain.

2. Half an hour after the injection of morphia, 40 c.c. of a 15 per cent. solution of magnesium sulphate, warmed to body temperature, are injected subcutaneously. Should morphia have been given before the patient's admission to hospital, the administration of magnesium sulphate is carried out at once.

3. Two hours from the beginning of treatment, a second injection of morphia is given, the amount being adjusted according to the patient's condition, $\frac{1}{4}$ or $\frac{1}{8}$ grain.

4. Five and a half hours from the beginning of treatment 20 to 25 c.c. of the magnesium sulphate solution are injected. This reduced amount is given only where there have been no convulsions since the first injections of magnesium sulphate. Should convulsions have persisted, the dose is again 40 c.c.

5. Eleven and a half hours from the beginning of treatment, magnesium sulphate is again injected as described in paragraph 4.

6. Nineteen and a half hours from the beginning of treatment, magnesium sulphate is again administered. Should convulsions or their precursors have ceased, the dose may be reduced to 10 to 15 c.c. In cases of puerperal eclampsia, this injection may be omitted or be substituted by the giving of 5, 8 or 10 grains of veronal.

7. The blood-pressure is recorded at the beginning of treatment, but this should not be carried out more than twice in twenty-four hours. This restriction also applies to the taking of the patient's temperature.

8. At the beginning of treatment the patient should be catheterised and the urine examined. The amount of urine passed in twenty-four hours should be measured.

9. If the patient has had more than five convulsions before admission, venesection should be carried out and 400 to 600 c.c. of blood taken off. In the absence of such obstetric complications as an abnormal presentation, *the membranes should be punctured*.

10. Should the patient, treated from the beginning in hospital, have had three convulsions or only two very severe convulsions, the two procedures described in paragraph 9 should be carried out.

11. Where the first convulsion occurs during labour, a vaginal

examination should be made at once and the membranes punctured if the presentation, etc., are favourable.

12. From the first convulsion the patient should not be given any nourishment and only a minimal amount of fluid for forty-eight hours.

13. The avoidance of all causes of irritation to the patient, such as noises, violent movement, etc., should be most strictly observed.

14. After each convulsion oxygen should be administered for four to six minutes, or until cyanosis disappears.

15. The patient should be nursed on her right side, short temporary changes to the left side being made four or five times in twenty-four hours.

16. The patient must be kept warm by means of hot-water bottles applied to the feet and the loins, or special electrically warmed blankets. The bedclothes should be warm but light.

17. The room should be thoroughly aired four or five times per day.

18. The patient's mouth, pharynx and nose should be carefully cleansed of mucoid secretions at frequent intervals.

19. All interference with the patient, including treatment, examinations and operations, should be carried out expeditiously under general anæsthesia. Venesection should be carried out at the same time with puncture of the membranes, so as to make the greatest use of the anæsthesia.

20. The patient requires unremitting and skilled observation and nursing throughout the acute illness, and certainly for at least twelve to twenty-four hours after the last convulsion.

VARIATIONS IN THE CONSERVATIVE TREATMENT OF ECLAMPSIA.—While most of the procedures described in the Stroganoff scheme of treatment are included in the methods of other centres, there are one or two further measures which may be described.

In several centres the stomach is washed out with warm water or a dilute solution of bicarbonate of soda, and finally $\frac{1}{2}$ ounce of magnesium sulphate in concentrated solution is left in the stomach. If there is difficulty in passing the stomach tube, an anæsthetic may be necessary. The Dublin scheme of treatment requires the irrigation of the colon, with several gallons of alkaline solution, the procedure taking not less than half an hour. This treatment may be associated with some degree of shock, and certainly disturbs the patient.

Where convulsions continue, with a persistently high blood-pressure and a strong, rapid pulse, veratrine, a preparation of *veratrum viride*, may be administered in doses ranging from 1 to 0.5 c.c., the higher doses being given where the blood-pressure is very high. While this drug appears beneficial in many cases, it may cause collapse when administered to patients with low blood-pressure.

RESPONSE TO TREATMENT.—Good progress is indicated by the cessation of the fits, free perspiration, ample secretion of urine, a falling blood-pressure and a return of consciousness. It must be remembered

that some very severe cases have a persistently low blood-pressure—never over 140. The response to treatment may be so satisfactory that the patient appears completely restored to health in a few days, without having gone into labour. She may go to full time and give birth to a live child, though frequently the child in such cases is macerated. Cases of this type are described as having *intercurrent eclampsia*. The risks of acute recurrence are so great, however, that the safer policy is to induce labour in those patients as soon as they have recovered from the actual eclamptic attack.

Cæsarean section holds a limited place in the treatment of eclampsia. The operation is justified (a) in the *fulminating* variety; (b) where an obstetric abnormality is likely to make labour prolonged—it should be carried out immediately after the first fit. The longer the delay, the worse is the prognosis. To secure the best results from conservative treatment there should be minimal obstetric interference. A forceps operation is only justified when the second stage of labour is well advanced—a patient who is recovering from eclampsia may die from the shock caused by a difficult forceps operation.

SYMMETRICAL CORTICAL NECROSIS OF THE KIDNEYS

This condition is described in association with the toxæmias of pregnancy, because it occurs in pregnant women as a sequel to eclampsia or the most severe types of accidental hæmorrhage (p. 589). It may also occur in acute diseases apart from pregnancy, such as scarlet fever, diphtheria and acute pulmonary tuberculosis.

The appearance of the kidneys in fatal cases is characteristic. The cortex is represented by a pale yellow homogeneous band of necrotic tissue surrounding the whole organ. Immediately underneath the capsule a very thin layer of normal cortical tissue may be identified, depending for its blood supply on the small capillary vessels coming in from the capsule. Histological examination shows complete necrosis of most of the glomeruli and tubules, and the glomerular systems which remain intact show extreme engorgement of the capillaries. Around the areas of necrosis there is exudation and hæmorrhage, with thrombosis in the interlobular arteries. The extensive necrosis appears to be due to a complete arrest of the circulation in those interlobular arteries.

Various causes have been suggested for this extensive renal lesion. Spasm of the smaller renal arterioles, a characteristic feature in eclamptic patients (p. 226), may cause ischæmia and necrosis. In a case reported by Jardine, this obstetrical complication occurred in a woman suffering from Raynaud's disease. Other workers suggest a vaso-paralysis of the terminal arterioles, with blood stasis, exudation, hæmorrhage and finally thrombosis. The first theory is more in accordance with the phenomena observed in eclamptic patients.

CLINICAL COURSE.—A very great diminution in the secretion of urine takes place during the patient's convalescence from eclampsia or accidental hæmorrhage. At first the few cubic centimetres of urine may be stained with blood, but later only a very small amount of urine with a very low urea content can be obtained. As the condition develops, the urea retention of the blood becomes very marked, rising to 300 mg. or more per 100 c.c. At first the patient shows no disturbing symptom, and might be regarded as making a good recovery from her serious illness, were it not for the developing anuria. This symptomless state may continue for a week or more until there is a sudden collapse, sometimes with uræmic convulsions, sometimes with only coma. The blood-pressure is on occasion found to be quite low until the terminal phase. Death occurs in from seven to fourteen days.

The prognosis in cortical necrosis is very grave, and most cases end fatally. As soon as the condition is identified, energetic measures should be adopted. The most satisfactory method of treatment is the intravenous administration of hypertonic glucose—100 to 120 c.c. of a 25 per cent. solution of glucose may be given every eight hours. Another method is the continuous intravenous administration of a 5 per cent. solution of glucose in saline up to 3 to 5 pints in twenty-four hours. This type of treatment should be continued for several days, and in a favourable case a sudden diuresis will occur with a progressive fall in the urea content of the blood. Where the response is favourable, the kidney appears to make a complete functional recovery.

In this condition such heroic measures as *decapsulation* of the kidney and nephrotomy have been practised, but the nature of the renal lesion offers little support for such interference.

OTHER DISORDERS OF TOXÆMIC ORIGIN, OCCURRING USUALLY IN THE EARLIER MONTHS OF PREGNANCY

There are many disturbances, referable to certain organs or systems in the body, which occur during pregnancy, and for the origin of which no local lesion can be identified. These conditions seem to be of toxæmic origin and respond to anti-toxæmic treatment. The various conditions are described fully in the succeeding chapter.

CHAPTER XII

THE ASSOCIATION OF PREGNANCY WITH DISTURBANCES OF THE OTHER MATERNAL SYSTEMS

DISTURBANCES OF THE DIGESTIVE SYSTEM

HYPEREMESIS GRAVIDARUM and Acute Yellow Atrophy of the Liver have been considered among the toxæmias of pregnancy in the preceding chapter.

Gingivitis.—Slight swelling and hyperæmia of the gums may appear in a normal pregnancy and cause little discomfort. In some cases, however, the gums become swollen and spongy, and bleed upon the slightest touch : the teeth may become loosened. This occurs most frequently in women who neglect their teeth, or in those whose general nutrition is bad. There is no associated fetor or salivation, and there may be very little pain. The condition usually appears about the fourth month, and continues until the end of pregnancy. It may recur in a succeeding pregnancy. The cause is obscure ; by many, it is considered to be a form of toxæmia due to pregnancy alone. Deficiency of vitamin C in the diet may be an important factor (p. 147). Astringent mouth-washes containing tincture of myrrh should be given, combined with tonics and an ample diet with a high vitamin content. The condition clears up completely at the end of pregnancy, though it may be almost intractable during the pregnancy.

Dental Caries.—The changes which may occur in the teeth in pregnancy have been described already (p. 155). In association with the calcium changes, dental caries may occur, and toothache be troublesome. The condition may be so acute as to require extractions. Permanent conservative dental work should be postponed until the end of pregnancy. The administration of calcium and vitamin D may be helpful (p. 147).

Excessive Salivation.—Excessive salivation or *ptyalism* may occur in the early months of pregnancy, from the second to the fifth. It has been described as occurring in the later months, associated with slight albuminuria. There is a tendency for the symptom to recur in succeeding pregnancies.

The flow of saliva varies very much : it may amount to as much as 500 or even 1000 c.c. per day. The patient cannot swallow the saliva, because it is so nauseating. The secretion is very watery and tasteless, and contains very little ptyalin. As a result of this huge loss of saliva, digestion is impaired and loss of appetite results. The

patient is made very uncomfortable because of the constant dribbling, which may excoriate the chin. Nutrition may be much disturbed so that a progressive and severe loss of weight ensues. Insomnia is a frequent complication.

This disease coincides in the period of its incidence with hyperemesis gravidarum. It usually disappears by the fifth month. Treatment should be commenced as for a toxæmia by putting the patient on a fluid diet and improving excretion. An astringent mouth-wash such as alum, a drachm to the pint, should be used and a nerve sedative of the bromide type prescribed. Belladonna by mouth and hypodermic injections of atropine sulphate may be tried, but often fail to give relief.

Dyspepsia.—Many women suffer from varying degrees of dyspepsia. For acidity, milk of magnesia or soda-mint tablets may give relief. When there is actual "heart-burn," sodium bicarbonate should be used. In some cases gastric analysis shows very little hydrochloric acid, and the adjustment of this deficiency gives relief.

Constipation.—This is a very common accompaniment of pregnancy (p. 141). It may be associated with intestinal colic. An attempt should be made to secure regular bowel movements by a carefully adjusted diet, containing whole-meal bread, vegetables, especially as salads, and fruit, with a fluid intake of not less than 3 pints per day. Should this plan fail, laxative drugs will also be required, but they should be of such simple types as liquid paraffin, cascara sagrada, senna or liquorice. Strong purgatives should be avoided, particularly the large weekly dose of castor oil resorted to by so many women of the poorer classes.

Jaundice.—The grave forms of jaundice which occur in hyperemesis gravidarum, eclampsia and acute yellow atrophy have been dealt with. Mild catarrhal jaundice, accompanied by such symptoms as generalised pruritus, is not serious, but the possibility of this jaundice being the precursor of a more grave condition should not be lost sight of. The true catarrhal type clears up spontaneously.

In the epidemics of infective jaundice which have occurred, the mortality among pregnant women has been very high. Abortion, premature labour and death in coma have been common.

Gall-Stones.—Gall-stones occur more commonly in women than in men, and they occur more frequently in women who have borne children than in others. This would indicate some relationship between reproduction and the formation of gall-stones. The increase of cholesterin in the blood during pregnancy (p. 140) and the mechanical displacement of the viscera may be ætiological factors. Acute attacks occur in pregnancy, particularly in the second half or in the puerperium. When this complication occurs, surgical treatment should be carried out without reference to the pregnancy.

Acute Cholecystitis may occur in pregnancy, labour, or the

puerperium, and should also be treated without reference to the pregnancy.

In these gall-bladder affections, the diagnosis may be difficult, particularly in the puerperium, when they may be confused with an acute puerperal infection. During pregnancy, they have to be differentiated from pyelitis and appendicitis.

Appendicitis.—Pregnancy does not affect the incidence of appendicitis in any way, but it makes diagnosis more difficult. The enlarged uterus makes the assessment of muscle spasm and rigidity more difficult—for this reason appendicitis occurring in pregnancy may be missed, and the pain attributed to one of the minor local disturbances of pregnancy.

While pregnancy does not predispose to the condition, it may cause an exacerbation in an old-standing case, especially where the inflamed appendix has become adherent to the uterus or appendages, and is put upon tension by the enlarging uterus. When abscess formation has developed, rupture may take place during the puerperium owing to the rapid decrease in the size of the uterus—a most serious complication unless immediate surgical treatment is carried out.

An initial appendicitis may occur as readily as at any other time. The inflammatory lesion may be very acute owing to the vascularity of the pelvis. On the whole the dangers of an acute attack of appendicitis are greater than in the non-pregnant condition, owing to the displacement of the caput cæcum above the pelvic brim by the enlarging uterus.

Diagnosis.—For diagnosis, there is the pain on the right side of the abdomen, with elevation of the temperature and the pulse. A differential diagnosis has to be made from pyelitis, biliary or renal colic, inflammatory conditions of the adnexa and extrauterine pregnancy. In the puerperium, appendicitis may be confused with an acute septic puerperal infection. Probably the greatest difficulty is to make a differential diagnosis from pyelitis; the decision here often depends on the examination of the urine for pus cells.

Treatment.—When a diagnosis of appendicitis has been made, surgical treatment should be carried out without reference to the pregnancy. In operating in the later months, there is the mechanical difficulty of exposing the parts concerned in a satisfactory way owing to the bulk of the uterus, and also in securing satisfactory drainage. The operation is attended with less difficulty in the early months, and abortion is not likely to occur unless manipulation has been excessive. In the later months premature labour may occur, especially in cases where abscess formation has taken place. This may be due to pyrexia or to the transmission of the actual organisms to the foetus.

Intestinal Obstruction.—Intestinal obstruction has been reported in cases of retroflexion of the uterus, and of fibromyomatous tumours. It may occur quite adventitiously during pregnancy from other causes,

such as tuberculous peritonitis. The case should be treated without reference to the pregnancy.

Hernia.—The patient may feel a certain amount of discomfort from a pre-existing hernia during the earlier months of pregnancy; but as the uterus increases in size, it pushes the bowel back from the opening. During the puerperium the bowel may find its way into the sac through the enlarged and relaxed ring, but incarceration very seldom occurs. During labour, the opening is usually closed by the enlarged uterus and no protrusion is possible during the voluntary efforts of the second stage.

A hernia in which complications develop should be treated without reference to the pregnancy.

DISTURBANCES OF THE VASCULAR SYSTEM

Cardiac Disease.—While in a normal pregnancy there is a degree of cardiac hypertrophy, there is also a considerable demand made on the heart's reserve force. The pregnant woman finds that a task, which formerly caused her no effort, now brings on an attack of breathlessness. During the later months she cannot climb the stair, which she had hardly noticed before as requiring any effort, without considerable discomfort.

When there is such a demand made on the reserve force of the normal heart, it is natural that a heart, the efficiency of which is already impaired, will suffer still greater embarrassment. The difficulty is to tell how far the efficiency of the heart has really been impaired, and how much reserve force it still has at its disposal. The late Sir James Mackenzie did much to improve our appreciation of cardiac efficiency. He showed how little information is gained regarding the efficiency of a heart by identifying murmurs, even though they may be due to organic valvular lesions. Our judgment must be based upon the heart's response to effort; inadequate response is indicated by heart failure, which should be recognised in the early stages from its association with breathlessness, pain on effort, and irregularity in the action of the heart itself. Dropsy, enlargement of the liver, œdema of the bases of the lungs, and cyanosis are only indications of the terminal stages of heart failure.

In all cases, heart failure is associated with an impairment of the integrity of the heart muscle, of which the most typical manifestation is auricular fibrillation with a fast ventricular rate. Under still greater strain, such hearts are liable to be associated with multiple infarctions in the lungs, and finally, acute cardiac dilatation with collapse. How far cardiac failure in pregnancy may be favoured by the circulating toxins (invariably present even in a normal pregnancy) acting on the cardiac musculature is an interesting speculation.

PROGNOSIS.—Using the labels conventionally associated with heart

disease, Mackenzie found that systolic murmurs by themselves, wherever they may be best heard, need never be a cause of anxiety in pregnancy. While the type of cardiac lesion which gives rise to most anxiety during pregnancy is mitral stenosis, usually a rheumatic sequela, the actual prognosis depends on the degree of compensation in the individual case. In aortic regurgitation, a rare condition in women, the prognosis is only grave when there is much hypertrophy of the ventricle and a marked Corrigan pulse. In women with easily excitable hearts, who suffer at times from pain of varying degrees of severity, where the organ is of normal size or only slightly enlarged, the cardiac condition is not likely to cause any trouble in pregnancy.

The most accurate prognosis for cardiac patients during pregnancy can be obtained by assessing the degree of functional impairment when the patient first presents herself for examination. The following scheme of classification has been prepared by cardiologists, and the prognosis in pregnancy is indicated in each group :—

Group 1 is composed of those who, though suffering from organic heart disease, are able to perform their habitual physical activities without any unusual fatigue, distress or dyspnoea.

The disease in this group, being practically symptomless, is as a rule discovered in the course of routine examination. In this type, compensation being good, the prognosis is favourable, although not invariably so.

Group 2 (a) is composed of those who are able to perform their usual activities, but have some slight discomfort in doing so. They have a slight limitation of physical activity, which shows itself by shortness of breath on climbing stairs, on walking uphill, or after performing their usual household duties.

Pregnancy and labour usually present no great difficulty for these people, though if the second stage be prolonged, the timely use of forceps is required.

Group 2 (b) is composed of those patients who have a definite limitation of physical activity. They are unable to perform the more arduous everyday duties without showing some degree of distress, such as shortness of breath or palpitation. It will be found that the symptoms produced by the overworked heart are severe enough to limit their activity. They are not able to climb a flight of stairs without several halts ; they have given up the heavier duties of house-keeping, such as clothes-washing ; at night the ankles may be a little swollen.

These people require advice and treatment for the relief of the cardiac condition, but, depending on the response to the measures instituted, the majority are found fit enough for a natural labour.

Group 3 is composed of those few people whose cardiac reserve is at a minimum. They are unable to carry on any physical activity without discomfort, and in consequence they have been forced to

give up all household work. They can only walk a few yards, and that with difficulty. They have a greater or less degree of heart failure even at rest in bed, and on examination they generally have signs of congestion of the peripheral circulation. This shows itself by the presence of œdema, dyspnœa, increased venous blood-pressure, and in more advanced cases by orthopnœa and the deeper hues of cyanosis.

Should a woman in this state of decompensation reach the later months of pregnancy, labour is associated with considerable danger, but a natural labour at full term, relieved, if necessary, by the timely use of forceps, is likely to be less dangerous than surgical interference, *e.g.* by Cæsarean section, before full term. The only procedure which can be recommended to bring on labour in such a case is simple puncture of the membranes. The cardiac reserve is minimal and the least additional strain will overburden the heart and precipitate a fatal issue either immediately or in the early days of the puerperium. Fortunately, with adequate medical care, much can be done to avoid such a catastrophe.

TREATMENT.—(a) *During Pregnancy.*—All cardiac patients must be kept under careful supervision throughout pregnancy. A case which is placed in Group 1 at the fourth month may have reacted unfavourably and require to be transferred to Group 2 (a) at the ninth month. Similarly, a Group 2 (a) case may drift into Group 2 (b). When cardiac impairment becomes progressive during pregnancy, treatment should be instituted. The first form of treatment is always complete rest in bed, with attention to diet and elimination. In more severe cases the use of digitalis or strophanthus may be necessary. Recently great help has been secured by the copious administration of glucose. Where these conservative measures fail to produce adequate improvement, the termination of the pregnancy may have to be considered.

A review of a large series of cases shows that the termination of pregnancy is seldom necessary, particularly where the patient is under competent supervision throughout her pregnancy. A considerable proportion of cases in Group 3, however, do require such treatment. Their condition at the beginning of pregnancy and their poor response to conservative treatment show the danger of the continuing pregnancy. It is very important to identify such cases by the fourth month. While at the very beginning the uterus may be fairly easily emptied from the vagina, it is much more satisfactory to perform abdominal hysterotomy and, at the same time, sterilise the patient. The operation should be performed under nitrous oxide and oxygen, spinal anæsthesia, or local anæsthesia. Among special indications for interference at this stage is paroxysmal tachycardia, especially when associated with precordial pain and exhaustion.

Later in pregnancy a more conservative attitude is justified. The prospects of a satisfactory normal labour are good. In such patients, labour is frequently premature and the foetus, as a result of the

mother's impaired health, is often small. Multiparæ under those circumstances may have practically a precipitate labour. The actual intrapartum care is described below. Even when it is undesirable that the patient should go through another pregnancy, it is better to let her go through a natural labour, and have a surgical or X-ray sterilisation carried out later.

Only where there has been acute failure of compensation, or where there is some obstetrical complication likely to make labour difficult, should Cæsarean section be resorted to in the later months. For such cases, induction by bougies, etc., is quite unsuitable. The patient's condition should be stabilised as far as possible before operation by the administration of digitalis and glucose, and the operation should be carried out under gas and oxygen, spinal or local anæsthesia.

One of the gravest dangers which can befall a pregnant woman already handicapped by cardiac valvular disease is the occurrence of some acute infective illness, such as tonsillitis, influenza, or gastro-enteritis. Reinfection of the valves may occur with the establishment of fresh vegetations, which may develop into malignant or ulcerative endocarditis, or allow the detachment of emboli. When an acute infective illness occurs in such a patient, she should be most carefully nursed and kept in complete rest for an adequate period, several weeks if necessary, after the acute phase has passed.

In all cardiac cases it is good policy to make the patient rest in bed for a fortnight before term so that compensation may be at its best when labour begins.

(b) *During Labour.*—*During the First Stage.*—A most careful watch should be kept. If there is auricular fibrillation, give abundant glucose, and digitalis in full doses, up to 20 minims of the tincture four-hourly. Where there is cyanosis and embarrassment of the pulmonary circulation, venesection up to 300 or 400 c.c. should be carried out. The patient should be allowed to adopt the attitude, reclining or otherwise, in which she is most comfortable. Should acute collapse occur, inject camphor in oil, coramine or other such cardiac stimulant, administer oxygen and give glucose per rectum. Operative interference at this point will add to the shock, but if there is only a rim of undilated os externum, the cervix may be incised and the child delivered with forceps. *In the Second Stage.*—An anæsthetic should be administered and the child extracted with forceps or by version. No "bearing down" should be allowed to occur. Pituitrin is to be avoided in these cases. A primipara may be left a little longer in the second stage than a multipara, to allow a little more dilatation of the soft tissues. *In the Third Stage.*—Free bleeding should be allowed to occur, especially in cases of mitral stenosis. If the hæmorrhage is scanty, it may be advisable to do venesection; but if it is too profuse, use a hot intrauterine douche. Ergot should not be used. A tight binder should be applied. Great distress with intense cyanosis may appear

during or at the end of the third stage, owing to the blood which had been circulating in the uterine wall being suddenly driven into the right side of the heart. This should be relieved by venesection.

(c) *Puerperium*.—The patient should still be watched carefully, as signs of cardiac failure may appear as late as the fifth or sixth day. Should there have been a tendency to auricular fibrillation, the administration of digitalis or strophanthus should be continued. A sudden attack of cyanosis should be treated by prompt venesection. A more dangerous complication is the reinfection of the cardiac valves, usually by the *streptococcus viridans*, coming from even mild intrauterine infection, which, in a healthy woman, would probably have remained localised in the birth canal.

Varices.—In over 20 per cent. of women, the veins of the leg, thigh and vulva show marked varicosity. While these are sometimes attributed to the weight of the uterus pressing on the returning vessels, such an explanation does not seem very sound. The uterus does not press on these vessels; but, if it did so at any time, it would be at a stage later than that at which the varicosities usually appear. The cause is something more subtle: it is more probably due to a change in the vessel wall or in the circulating blood, and may be a response to the action of progesterone. These lesions may appear very early in pregnancy. The varices of the vulva cause much discomfort and pain, and are liable to injury. Their rupture may cause fatal hæmorrhage. In rare cases the excision of an almost pedunculated varix of the vulva may be advisable during pregnancy. The danger of rupture of the vulvar veins during labour should be remembered.

The veins in the legs may be treated by injections and carefully applied bandages should be worn. During pregnancy the patient should raise her feet when she sits, and should avoid standing too long. If the veins become inflamed, absolute rest in bed, with the foot of the bed raised, and the application of belladonna and glycerine on lint to the inflamed veins should be carried out.

Phlebitis.—The gross infective *phlegmasia alba dolens* of the puerperium is described in Chapter XXXVII (p. 648). In women who have marked varicosities, thrombosis of the superficial veins of the thigh may occur during pregnancy and cause a superficial phlebitis. This also may be treated by the local application of belladonna and glycerine. It is advisable that the patient should rest the leg as much as possible.

Œdema.—Œdema is a common complication of pregnancy, and in its graver forms occurs in association with pre-eclampsia, eclampsia, chronic nephritis or cardiac disease. Even when there is no evident focal lesion, the condition should always be viewed with suspicion; it is often the precursor of a toxic albuminuria (p. 209). The lower limbs are usually first involved, and the vulva may become intensely œdematous. This œdema can hardly be due to the mere weight of a normal-sized pregnant uterus; it is more probably a toxic manifestation

due to increased permeability of the capillaries. Patients should be warned that it is an abnormal condition, and that they should at once report its appearance to their medical attendant.

There are a few cases in which the oedema appears to be due to excessive pressure—*e.g.* hydramnios and plural pregnancy. Again, it may be found in some patients in whom no causal lesion or other toxæmic manifestation can be identified. The patient may suffer extreme discomfort from oedema of the vulva; rest in bed may not give adequate relief. In such cases it may become necessary to puncture the distended skin with a sterile needle, but in this operation the greatest care should be taken to avoid infection of the swollen tissues.

Diseases of the Blood.—ANÆMIA.—Recent investigations on diet and nutrition in this country have shown a very high incidence of anæmia associated with pregnancy and the puerperium. This complication occurs particularly among women in poor nutrition who have had several pregnancies—the average number of births in one large series of cases was five. In tropical countries similar types of anæmia are found in pregnant women associated with alimentary infections, parasitic disease, poor diet and bad hygiene. The factor which appears to determine the occurrence of anæmia during pregnancy is the very heavy demand made by the fœtus for iron: not only must there be enough iron available for immediate tissue formation but also to provide the fœtus with a sufficient reserve, stored in the liver and other organs, for the first year of life (p. 144). The fœtus obtains two-thirds of its supply of iron during the last three months of pregnancy, during which phase the signs of anæmia usually appear.

The anæmias of pregnancy are usually divided into the *pseudo-pernicious* and the *secondary* types. The pseudo-pernicious type, formerly regarded as rare,¹ has been found in 30 cases, as compared with 70 of the secondary type in a group of 100 cases of anæmia associated with pregnancy investigated by Dr Moira Stevenson in the wards of the Royal Infirmary and the Royal Maternity Hospital, Glasgow.

(a) The *pseudo-pernicious type* shows the blood picture of a macrocytic hyperchromic anæmia, but differs considerably from true Addisonian anæmia. It occurs at an earlier age, is of more rapid development, is associated with multiparity and poor nutrition and responds more rapidly to suitable therapy. The blood picture reflects a more plastic bone marrow, and varies with the chronicity of the illness: the red cells are occasionally deficient in hæmoglobin. The anæmia usually appears between the sixth and the eighth months, is insidious in onset and associated with progressive pallor, frequently developing into icterus of the conjunctiva or skin. There may be oedema, and a mild degree of pyrexia is found in about two-thirds of the cases—this pyrexia may suggest an infective lesion when the

¹ The condition does not appear to be extremely rare in this country, to judge from recent papers by Davidson, Davis and Innes (*Brit. Med. Jour.* (1942), vol. ii., 31) and by Fullarton (*Brit. Med. Jour.* (1943), vol. i., 158).

condition is first identified in the puerperium. Glossitis may be troublesome. Gastric analysis always shows an excess of mucus, with abundant mixed flora, but varying amounts of hydrochloric acid. Retinal hæmorrhages are frequently found.

In addition to showing a high colour index in most cases, the blood picture shows an increase in the size of the mean diameter of the corpuscles. Stained films show anisocytosis, with many megalocytes. The leucocyte count varies, but there is a relative increase in the polymorphs and younger cells of the granular series of leucocytes. There is marked polychromasia and a slight increase in the reticulocyte count. Nucleated red cells, normoblasts, erythroblasts and megaloblasts are common.

The patients usually show a rapid response to treatment with whole liver but not always to liver extracts administered orally, intramuscularly or intravenously. Blood transfusion is helpful in very acute cases, or where the response to liver therapy is unsatisfactory. Where the hæmoglobin content of the blood rises slowly the addition of iron therapy is helpful. As a rule the blood picture regains normal characters within about four weeks from the initiation of treatment, and maintenance therapy is then unnecessary.

In the group of 30 cases referred to previously the average number of pregnancies was five. There was no evidence of sepsis as a cause, and actual hæmorrhage of the antepartum or postpartum types was infrequent: when it did occur, it was only a further complication of an already established anæmia. Blood examination showed evidence of hæmolysis in many of the cases, but never in excessive amount.¹ Poor nutrition was present in the whole series, due either to deficient diet or to anorexia and vomiting. The most important factors appeared to be an insufficiency of the *extrinsic factor*, supplied normally from meat proteins, together with a temporary deficiency of the *intrinsic factor*, normally found in the gastric juice. Of the 30 cases, 2 ended fatally—both very ill when first seen. This type of anæmia is liable to recur in subsequent pregnancies.

(b) The *secondary type* of anæmia of pregnancy shows the characters of a *microcytic*, hypochromic anæmia. In many cases there is an obvious cause, such as antepartum or postpartum hæmorrhage, pyelitis or albuminuria. In the special series of 70 cases of this type, already referred to, the average number of pregnancies was five: in 50 cases there was very deficient nutrition. The clinical history is that of progressive pallor and debility during a series of pregnancies, with partial or complete remission some months after delivery. In the more severe cases icterus occurs, and glossitis is occasionally found. In most cases the spleen is palpable, and the urine shows an excess of urobilinogen. Gastric analysis usually shows a hypochlorhydria.

¹ There does occur occasionally an "acute hæmolytic anæmia"—the onset of this grave form may be quite sudden. If the condition does not respond quickly to medical treatment the pregnancy should be terminated.

Blood examination gives a low colour index. Microcytosis is the characteristic feature, but there may be some fairly large polychromatic cells. The leucocyte count gives either a normal figure or a slight leucocytosis. Hæmolysis is occasionally found.

Cases of this type respond readily to treatment with iron in large doses—30 grains of a scale preparation or 6 grains of ferrous sulphate three times daily. In cases dating from a postpartum hæmorrhage the administration of liver may also be necessary: where there has been a recent severe hæmorrhage a blood transfusion is advisable. When the blood picture regains normal characters, maintenance therapy is seldom necessary. The important factors in the development of this condition are the physiological demand for iron during pregnancy, poor dietary and abnormal gastric secretion. It has been found that patients suffering from hypochromic anæmia give a more satisfactory response to iron therapy when there is free hydrochloric acid in the stomach content than in comparable cases with achlorhydria. In the series of 70 cases referred to none ended fatally. This type of anæmia may recur in a subsequent pregnancy, but is easily controlled.

While two well-defined types of anæmia have been described as associated with pregnancy, intermediate cases may be found combining the morphological and possibly the ætiological features of both. Cases of true *Addisonian anæmia* due to deficiency of the intrinsic factor may become complicated by pregnancy, or be first manifested during pregnancy or the puerperium. In tropical climates macrocytic anæmia due to deficiency of the extrinsic factor may occur. Idiopathic hypochromic anæmia due to iron deficiency may become complicated by pregnancy, or be first manifested during pregnancy or the puerperium. Further, various types of anæmia associated with some condition other than pregnancy, for example, malaria, syphilis, tuberculosis, neoplasms or leukaemia, may become complicated by pregnancy.

LEUKÆMIA.—This is a very rare complication of pregnancy. While it has no direct effect on the pregnancy, the association of these two conditions is very harmful to the mother. A diagnosis is made from the anæmia, enlargement of the spleen, and the characteristic blood film. The characteristic leucocytes do not pass over to the foetus. Premature labour may result with marked improvement in the symptoms: and when the condition of the mother becomes grave the pregnancy should be terminated artificially.

HÆMOPHILIA. Hæmophilia generally affects men, but there is no positive proof that it will not affect women. The gravest danger is in the third stage of labour. The treatment of such a condition is very difficult. Calcium chloride and gelatin may be prescribed to encourage clotting. Heterogeneous sera, such as horse sera and occasionally human sera, have been tried. Blood transfusion is essential when actual hæmorrhage occurs.

PURPURA HÆMORRHAGICA.—This is a very rare but extremely

dangerous complication of pregnancy. Sixty per cent. of the cases recorded ended fatally. In most cases the condition has been found about the sixth or seventh month in women who have had several pregnancies. Lassitude, headache and slight pyrexia are the early symptoms. The treatment is symptomatic and blood transfusion may be advisable.

LEAD POISONING.—This used to be a very common lesion among factory women who handled lead in the course of their employment. In 60 per cent. of the cases abortion or premature labour occurred, and a considerable number of the live-born children died of debility. The lead passes through the placenta and affects the fœtus. To-day the use of lead, purchased very often in diachylon plaster to procure abortion, is unfortunately very common. Animal experiments have shown that males suffering from lead poisoning are sterile, or, when fertile, procreate debilitated young, with a high early death-rate.

DISTURBANCES OF THE RESPIRATORY SYSTEM

Pneumonia, influenza and pulmonary tuberculosis will be dealt with among infective diseases in the succeeding chapter.

Chronic Bronchitis and Emphysema.—Those associated conditions have not usually reached a very advanced stage or led to extensive organic lesions even by the end of reproductive life in women. When pregnancy does occur in such cases the enlarging uterus may cause much respiratory distress. Then the patient should be kept in bed and the bronchitic condition treated. In some cases the dyspnoea becomes so severe that pregnancy has to be interrupted; less commonly premature labour occurs. During labour the same precautions may have to be carried out as have been described for cardiac cases (p. 244).

Asthma.—In patients with an asthmatic tendency the occurrence of pregnancy is likely to precipitate a series of attacks of the disease. In some patients asthma makes its first appearance in pregnancy. Very occasionally it is relieved by pregnancy. Although it usually disappears completely at the end of pregnancy, cases occur in which it persists as a serious disability. The chief ætiological factor is probably allergic. The condition has been found associated with an albuminuria. The usual asthmatic remedies should be employed, special attention being paid to dieting and stimulating excretion. In obstinate cases a change of air may prove most beneficial.

Dyspnoea.—Breathlessness on even slight exertion occurs in practically all women in the later months of pregnancy, and is due partly to the upward pressure on the diaphragm, and partly to the heavy demands made on the maternal heart at that stage. Dyspnoea of a severe type is a frequent complication of hydramnios and plural pregnancy. When dyspnoea occurs early in pregnancy it may be due to cardiac or renal lesions and requires careful investigation and appropriate treatment.

DISTURBANCES OF THE NERVOUS SYSTEM

Chorea.—Women who have suffered from chorea in adolescence are prone to have a return of the disease in pregnancy; others, who have had rheumatic fever or some other rheumatic manifestation at an earlier age, develop chorea for the first time during pregnancy. There is still another type of case in which the young primigravida, with no history of rheumatism, acquires her first attack of chorea during pregnancy. In practically all cases the clinical picture is that of a true Sydenham's chorea; in a few cases the type and the clinical history resemble the Huntington variety very closely. The rheumatic diathesis has been regarded as the chief etiological factor, but recently attention has been drawn to the possibility of a more definitely toxæmic origin. Few of the cases, however, show even albuminuria, which may be regarded as one of the cardinal signs of toxæmia in pregnancy. By far the greatest number of cases of chorea in adults occur in pregnant women. The condition, having appeared in one pregnancy, may recur in the succeeding pregnancies, but does not always do so.

This complication of pregnancy must be regarded as a fairly serious one, with a maternal mortality of 10 to 15 per cent., and a foetal mortality of about 40 per cent., the latter being due to prematurity or intrauterine malnutrition. The analysis of a large series of cases has shown that where the onset of chorea preceded pregnancy, the prognosis was most favourable—there were no fatal cases. When the onset occurred in the first, second or third three months of pregnancy, the mortality was respectively 15, 16 and 21 per cent. The prognosis was always bad in febrile cases. While in most cases pregnancy proceeds without interruption, abortion or premature labour occurs in about 15 per cent. The condition usually clears up completely at the end of pregnancy; in a small number, especially where it has appeared early, it may disappear during the later months, whereas in the most grave types it may persist after the induced or spontaneous termination of pregnancy.

Chorea may appear within the first three months of gestation; it may appear also in the later months, but it begins most commonly in the fourth or fifth months. The movements are usually much more violent than in other forms of chorea. Their extent may be so great as to interfere with speech, deglutition and even respiration. Eating and sleeping may be thus interfered with and wasting may become very pronounced. Mental disturbances of the delusional type are common, and may develop into actual insanity, which may persist for several weeks after the pregnancy has terminated. In the most severe cases the temperature rises, and this should be regarded as a very grave prognostic sign. In a large number of fatal cases ulcerative endocarditis has been found.

Treatment.—The patient usually requires to be removed from her

home surroundings. All sources of worry or irritation should be dealt with. Seclusion is beneficial in preventing excitement. Confinement to bed must be enforced and the food intake should be made as great as possible, instead of being cut down to the fluid diet which would be suitable for a true toxæmic case. In many cases the salicylate drugs have been helpful; in others good results have been obtained by the administration of arsenic in the form of Fowler's solution, the initial dose of 3 minims thrice daily being rapidly increased up to 10 minims thrice daily. This should be continued until signs of intolerance appear—*e.g.* diarrhœa—when the treatment must be stopped for a time. The movements may have to be controlled by large doses of sodium bromide, chloral, hyoscine or even morphia; sometimes chloroform is necessary, and is well borne by the patient. Sleeplessness has often to be treated by the sedatives mentioned above.

Sometimes, in spite of all these measures, the patient shows signs of great exhaustion, resulting from the incessant movements, the loss of sleep and the lack of food. Such a change in condition usually proceeds with alarming rapidity and is associated with the onset of fever. In such cases the termination of pregnancy has to be considered, the method to be employed depending on the stage of the pregnancy (pp. 732-741). Bad results have been reported from such treatment, but these bad results, as in cases of hyperemesis gravidarum, are probably due not so much to the radical treatment as to the fact that its adoption had been delayed until the patient was too weak to stand it. While expectant treatment, so far as the pregnancy goes, is preferable, occasions do arise when interference becomes necessary.

Epilepsy.—Women who have suffered from epilepsy appear to be little influenced by the incidence of pregnancy. In a few cases the fits become more frequent during pregnancy; in others they become most alarming in frequency and violence during labour. Analysis of the histories of a large number of women epileptics has shown that in a very small number pregnancy, labour or the puerperium has been the starting-point of the epilepsy itself. Perhaps the greatest clinical importance of epilepsy in pregnant women is the care which must be taken to distinguish it from eclampsia. While there is, as a rule, no albumin in the urine of epileptics, albuminuria may eventually appear in cases in which the epileptic seizures become much exaggerated during labour; the histories of the two conditions, however, are absolutely different. The actual fits are similar in many respects. In cases where treatment becomes necessary owing to the increased frequency of the fits during pregnancy, potassium bromide or luminal is quite satisfactory, while in severe cases in labour these drugs are required in enormous doses. While there is seldom a clear indication for the termination of a pregnancy on account of epilepsy, there may be such progressive mental deterioration with succeeding pregnancies in such patients that sterilisation should be considered.

An epileptic mother should not be allowed to nurse her child, lest it sustain some injury at the onset of one of the mother's seizures. Lactation should be arrested not only in the interests of the child but also because the disease appears to be aggravated by this function in some cases.

Neuritis.—Pregnant women frequently suffer from mild forms of neuritis, with sensations of tingling and numbness, especially in the hands. This condition may become more marked, with sensitiveness along the course of the ulnar nerve, puffiness or cyanosis of the hands, diminished tactile sensibility and frequency paræsthesiæ. This local condition should be treated on the same principles as are described for *polyneuritis*.

POLYNEURITIS.—In the early months of pregnancy a very severe type of polyneuritis may occur, practically always as a sequel to a severe or a prolonged attack of hyperemesis gravidarum.

The earliest symptom may be numbness and itching in the feet and hands, but this is soon followed by progressive weakness, atrophy of the muscles, especially of the extensor groups, which show the reaction of degeneration. Bilateral drop-foot and drop-wrist may appear. There is marked sensitiveness along the course of the affected nerves, associated with shooting pains. There may be loss of memory or mental confusion. In the most severe type the phrenic or intercostal nerves may become involved, resulting in death from respiratory failure. The mortality in this condition has been found to range from 15 to 25 per cent. Degenerative changes are found in the nerve trunks and also in the cells of the anterior horn of the cord.

Formerly regarded as a manifestation of toxæmia, this condition is now graded with the deficiency diseases. The essential deficiency here is in the vitamin B complex (p. 146), and the starvation associated with the preceding excessive vomiting may be regarded as a predisposing factor. The administration of vitamin B to all women who are much disturbed by vomiting in the early months of pregnancy is sound prophylactic treatment. Should a patient, suffering from or apparently recovered from a severe attack of hyperemesis, complain of muscular weakness or show mental symptoms, she should be carefully examined for evidence of muscular degeneration: should such evidence be found, she should have concentrates of vitamin B administered by intramuscular injection, as well as by mouth, where continued vomiting does exclude this route. Where polyneuritis is already established, this curative treatment must be supplemented by the use of salicylates or even sedatives for the relief of pain. After the acute phase has passed, massage, electrotherapy and orthopædic appliances are necessary to prevent deformities. The termination of pregnancy will seldom arrest the progress of the disease in severe cases, and complete recovery in favourable cases will occur with a continuing pregnancy.

TRAUMATIC NEURITIS.—During the puerperium, traumatic neuritis

may occur as a result of damage to the lumbo-sacral plexus during a difficult forceps delivery. The peroneal portion of the sciatic nerve is most frequently affected. In the early stages there may be great pain, with numbness of the affected limb. Drop-foot soon develops. The condition should be treated by massage, electrotherapy, and appliances to control the condition of drop-foot, but complete recovery may require many weeks of treatment.

Paralysis.—Paralysis may occur during pregnancy in cases of severe toxæmia, either of the hyperemetic or of the eclamptic type; in the puerperium it may follow cerebral thrombotic lesions in infected cases. In some of the former group recovery occurs after the termination of pregnancy, but in most cases, as in almost all of the second group, permanent damage is sustained. Sometimes a temporary paresis of the lower limbs results from the pressure of the foetal head on the nerves in the pelvis, but this phenomenon is more commonly the cause of varying degrees of neuralgia of the lower limbs, associated sometimes with intense muscular spasm. The more severe types of this lesion may prove intractable during pregnancy and difficult to relieve even after its termination.

PARAPLEGIA.—A complete paraplegia occurs occasionally in toxic cases, but the commoner type is where pregnancy has occurred in a woman suffering from lateral sclerosis. In the latter type the spinal lesion may not be affected by the pregnancy; in others it progresses markedly, extending from the lower to the upper limbs. With this progress there is usually some albuminuria, and vomiting may be troublesome. There is much wasting of the tissues, and the sphincters are uncontrolled. Cases have been recorded in which pregnancy has occurred after a spinal injury located high in the dorsal region. When paraplegic patients go into labour they experience very little discomfort—the labour is almost painless and the uterus expels its contents without difficulty.

Treatment must be directed to the patient's general condition—*e.g.* the regulation of the diet, the prevention of bedsores, etc.

Apoplexy.—This is an infrequent occurrence in pregnancy. When it is found, it may be associated with old-standing syphilis, chronic nephritis or valvular disease of the heart. It is a frequent complication in eclampsia and one of the common causes of death in such cases (p. 230). In the non-eclamptic cases the patient must be carefully watched when labour comes on, lest the expulsive efforts of the second stage cause further rupture of the cerebral vessels.

A very peculiar *transient aphasia* is sometimes met with, almost certainly of toxæmic origin (cerebral thrombosis).

Hysteria.—In women who are subject to hysterical attacks, pregnancy very often improves their physical condition so much that the hysterical manifestations remain in abeyance. In a considerable number, however, the outbursts occur with increased frequency and

violence. These attacks appear to have no influence on the pregnancy. Occasionally hysterical attacks may simulate eclamptic seizures, but the absence of albuminuria and the low blood-pressure make the diagnosis fairly easy.

Insanity.—Many women show signs of change of disposition during pregnancy. They may become irritable in temper, capricious in appetite, or express great aversion to what may have been formerly objects of interest and affection to them. These changes are specially marked in women of a nervous temperament. In a certain number the aberration is so marked as to constitute an actual insanity of the maniacal or melancholic type. Further dangers occur for such women at the end of pregnancy—the strain of a prolonged labour, septic processes in the puerperium, or exhaustion produced by prolonged lactation may upset the patient's mental equilibrium. Certain factors increase the risk of such complications—*e.g.* a history of previous mental disturbance in the patient, a bad family history, personal anxiety arising from the death of the husband or the illegitimacy of the child. *The border-line is very often crossed after a prolonged period of insomnia, a symptom which is very common in pregnancy and which should never be regarded as of no consequence.* The incidence of insanity as a sequel to the coma of eclamptic patients has already been referred to (p. 228).

(a) DURING PREGNANCY.—The onset of insanity during pregnancy is a more grave complication than during the puerperium or lactation. The prognosis varies according to whether the attack occurs early or late in pregnancy. In those cases in which the symptoms appear within the first four months, the patient will probably recover her equilibrium during the later months except the personal or family history is bad. When symptoms do not make their first appearance until the later months the condition is likely to persist throughout pregnancy, and to give cause for anxiety afterwards. Of the cases which arise during pregnancy and persist, 80 per cent. occur after the fifth month. The prognosis varies again with the type of insanity. The patient may have been subject to periodic mental disturbances during her whole life and the return of such symptoms during pregnancy is not fraught with any greater danger than at other times. For the patient herself the ultimate prognosis is not good, but the pregnancy is little influenced by the patient's mental state and progress, and *vice versa*. This is of course the alternating type of insanity. The other variety met with at this epoch is more common and more dangerous. The patient shows all the signs of a dementia præcox and the progress towards terminal dementia is sometimes fairly rapid.

The type which occurs early is associated with the period of morning sickness. The patient becomes suspicious of her relatives, even of her husband. She may complain that her food is being poisoned

and refuse to take it. She may show suicidal tendencies and may become homicidal, particularly towards young children. This type is seldom associated with acute depression. The type of later occurrence may show at first the same symptoms as the earlier variety, but marked delusions and very distressing hallucinations soon appear. The suicidal and homicidal tendencies are more marked than in the early type. Convalescence from this type is very protracted.

Treatment.—It is, in most cases, advisable to have the patient removed from her own home and from all her relatives. For most, a mental hospital is the only suitable place; for others it may be possible to incur the heavy expense of efficient treatment in a private house or nursing home with a view to securing the sentimental object of saving the child from the stigma of being born in an asylum. In all cases the patient must be strictly secluded, allotted a room on the ground floor, and watched day and night because of her suicidal and homicidal tendencies. Adequate nourishment must be secured, with abundance of plain, wholesome food. If all food is refused, forced feeding must be resorted to. Plenty of exercise in the open air should be taken to ensure an appetite for food and an inclination to sleep. The insomnia may be most obstinate—prolonged hot baths may be helpful, but in many cases the whole range of hypnotic drugs will be required. Paraldehyde, bromides, chloral, sulphonal, luminal and trional are most useful, while morphia and hyoscine may be required in periods of acute excitement.

The termination of pregnancy on account of definite manifestations of insanity has been much discussed by obstetricians and alienists. The former may have stressed unduly the policy of non-interference, while the latter may occasionally take too grave a view of the complication. A marked hereditary tendency to insanity or a history of puerperal insanity on more than one occasion should be regarded as definite indications for the termination of pregnancy. In all such cases this radical measure should only be adopted after consultation with an alienist. The same policy applies to the adoption of operative procedures to prevent pregnancy in a patient with a bad mental record. The patient should have the matter explained to her when she is in an absolutely normal mental condition and the husband and wife should be required to give a joint letter of indemnity to the surgeon.

(b) DURING LABOUR.—Some women show signs of acute maniacal excitement during labour, but this is usually a very transitory phenomenon which disappears with the completion of labour. The law recognises the possibility of temporary mental derangement during labour by the consideration which it gives to mothers accused of infanticide during or immediately after labour.

(c) IN THE PUERPERIUM.—About 5 per cent. of all cases of mental diseases in women takes the form of puerperal insanity. In addition to the general predisposing causes which have already been enumerated,

there are the *profound toxæmias* which occur in association with *eclampsia* and *puerperal sepsis*.

The commonest type of puerperal insanity occurs within the first week, and its onset is usually associated with rigors. Throughout the whole course of this attack the patient will probably have a febrile temperature, and the general attitude of the patient is one of feverish restlessness. The earlier the onset and the more violent the original excitement in these cases the better the prognosis. This is clinically a confusional insanity. Sometimes the signs of puerperal insanity do not occur until the end of the second week, and the patient may be by this time in a condition of great exhaustion. The symptoms are here those of the melancholic type and the prognosis is much more grave. The insanities of this stage are of the alternating type, though this may be the point of onset of a *dementia præcox*.

The duration of the mental disturbance in the early or confusional variety may be comparatively short. The patient suffers from sleeplessness and extreme restlessness; she may refuse food; she becomes depressed, conceives aversions to her husband and child, and may try to injure the baby or herself. She suffers from delusions, usually of suspicion, and from very disturbing hallucinations, commonly of smell or hearing. The process of involution is frequently disturbed, particularly as this type of mental disturbance tends to occur in septic cases. In most cases milk secretion is arrested and the lochial discharge is scanty. She often arrives at a stage of great weakness, with sunken cheeks, bright eyes, furred tongue, rapid pulse, incoherence and dirty habits.

From this stage she may pass through one of apathy or stupor to a convalescence lasting five or six weeks. Where the patient is put under treatment early and removed to suitable surroundings, the course of the disease may be much shortened and convalescence be established within a week.

Patients of this type should be removed to mental hospitals, except where the home conditions and facilities for nursing are exceptionally good. In all cases the patient must be completely isolated; her own child seems to be a specially disturbing factor. Treatment must be directed to combating the septic process present, dealing with the sleeplessness, securing a sufficient supply of nourishment and allaying the restlessness. About 80 per cent. of these cases recover completely.

In the cases where the mental disturbance is of the primarily melancholic type, the course of the disease is usually very prolonged, and the treatment must be entrusted to an expert in mental diseases.

(d) DURING LACTATION.—This period accounts for about 4 per cent. of all the cases of mental disease in women. The patients most commonly belong to the poorer classes and the immediate cause is malnutrition and exhaustion. The predisposing factors are the same as for the other varieties of insanity associated with pregnancy

or the puerperium. Sometimes the attack occurs so early as to resemble the puerperal type, not only in incidence, but also in character. In such cases the patient may suffer from acute excitement and restlessness; but in the more common variety of lactational insanity the symptoms are, from the beginning, those of acute depression. The onset is gradual, and irritability, sleeplessness, delusions and hallucinations develop. Suicidal and homicidal tendencies are common. The patient must be removed from her own home and, in most cases, owing to the class of patient in which this type is found, must be sent to a mental hospital. The whole treatment consists in good nursing and constant watching. About 75 per cent. of these cases recover completely.

DISEASES OF THE SKIN

The occurrence of pigmentation during pregnancy, particularly in the form of *Chloasma uterinum*, has been referred to on page 156. This condition is not amenable to treatment and disappears entirely during the puerperium in almost all cases.

The gradual distension of the abdominal wall usually stretches the skin beyond the normal limits of elasticity and causes the formation of the *Striæ gravidarum*. The patient seldom suffers any discomfort from this cause, but where she does, massage and inunction with olive oil give much relief. These conditions are practically physiological changes, whereas the other skin disturbances now to be described must be regarded as pathological.

Atrophic Changes in the Finger-nails.—Such a condition occasionally occurs in pregnant women as a result of malnutrition of the epidermal structures. The nails become loose and easily broken and there may be much local pain. Attention to the vitamin content of the diet (p. 145), with the addition of tonics, may improve the condition, but a complete cure may be delayed until the end of the pregnancy.

Urticaria.—Attacks of urticaria may occur during pregnancy or in the puerperium, in successive pregnancies. The patient may be very much disturbed, particularly by the sleeplessness caused by the continual irritation. Treatment must be carried out on general lines, copious elimination by the kidneys and the bowel being the chief requisite.

Pruritus.—Pruritus occurs in pregnancy either as a local lesion in the form of *Pruritus vulvæ* or, less commonly, as a general affection of the whole cutaneous surface. While the local lesion may result from the irritation of a vaginal discharge or other obvious local cause, general pruritus and many forms of pruritus vulvæ must be considered to be toxæmic manifestations. They occur most commonly among women of a nervous temperament. The condition usually occurs in the middle or later months of pregnancy, and may become most distressing. The

constant irritation, which is most marked at night, causes sleeplessness, resulting in exhaustion. The skin shows no changes apart from scratch marks, though occasionally erythematous or eczematous rashes may be present.

(a) *Pruritus Vulvæ*.—In this variety the presence of glycosuria should always be eliminated by urinary examination. If the patient is diabetic, the local condition will only be improved by general treatment (p. 270). Apart from a true diabetes there may be irritating vaginal discharges, associated with *thrush* (p. 283). A most obstinate pruritus may be associated with the presence of the *trichomonas vaginalis* (p. 283). Varicosities of the vulva, anal parasites, or lack of cleanliness may be the local cause. In the treatment of all these varieties scrupulous cleanliness must be observed. Where there is a vaginal discharge astringent antiseptic douches may be employed, such as 1 in 3000 potassium permanganate. Gonorrhœal discharges should be suitably treated (p. 282). Anal parasites should be dealt with by the use of santonin or enemata of infusion of quassia. The itching may be relieved by the use of ointments containing cocaine, menthol or carbolic acid until the causal lesion responds to local or general treatment.

(b) *General Pruritus*.—Treatment may be very disappointing in some cases. Nerve sedatives such as bromides should be tried, and the local treatment of the skin with 1 in 60 carbolic lotion is often helpful. The soundest treatment is to improve the patient's general condition by attention to diet and excretion. Some patients improve very markedly on a fluid diet, others on a dry diet with fluids between meals, while others do best on a vegetable and fruit diet. In very obstinate cases associated with severe insomnia, fatigue and progressive loss of weight, the pregnancy should be terminated.

Herpes Gestationis.—This form of herpes occurs in pregnant women and is now considered to be toxic in origin. It may occur in the same patient in successive pregnancies. The patient suffers very greatly from the itching and burning sensations.

The lesions usually begin on the legs and arms and spread to the face and chest. The course of the herpetic lesions is the same as in other forms of herpes—papules, vesicles, pustules and bullæ appearing indiscriminately.

The condition may be so severe as to cause insomnia. Treatment should be conducted as for a toxæmia and supplemented by the use of iron and arsenic tonics. An attempt should be made to treat the local lesions with carbolic acid lotion, bismuth and starch powder, or collodion.

Impetigo Herpetiformis.—This is a most dangerous form of impetigo which occurs almost exclusively in pregnant women, but it is fortunately very rare in this country. The mortality may be as high as 80 per cent.

Superficial pustules appear in groups or clusters, with inflammatory bases, and new lesions appear at the edges of the old. The lesions occur

typically on the trunk and thighs and on the genitalia. There are marked constitutional symptoms, with febrile disturbance, great prostration, delirium and vomiting. Abortion does not occur and the victims usually die undelivered.

Those clinicians who have had opportunities of studying this condition regard it as a pure toxæmia. The treatment is entirely palliative, but the mortality is very high. The injection into a vein of small quantities of blood-serum from a normal pregnant woman has been recommended. In favourable cases it disappears in the latter half of pregnancy.

DISEASES OF THE BONES AND JOINTS

While diseases of the bones and joints, such as rickets and tubercular caries, may cause deformities of the pelvis with resulting dystocia (Chapter XXX), the activity of such diseases during pregnancy is unusual. The extent to which the osseous tissues may be altered under certain conditions of nutrition has been referred to on page 147. The increased mobility of the pelvic joints has been referred to in some detail on page 121. In a few cases the loosening of the symphysis pubis is so great as to cause pain and difficulty in walking, with the adoption of a characteristic gait. A firm bandage round the hips usually gives the patient support, but sometimes the disability is so great that she has to lie in bed. Discomfort and pain may also result from a similar loosening of the sacro-iliac joints. The treatment is the same.

Osteomalacia.—Osteomalacia, though local in its incidence, is the most characteristic bone disease of pregnancy. This disease is found in over 90 per cent. of cases among women, and in some 72 per cent. of all cases among pregnant women. It is endemic in certain districts, namely, in the Rhine Valley, the city of Vienna, certain areas in Switzerland, Italy and the north of China. The endemic character of the disease is difficult to explain in terms of its ætiology.

There is no direct evidence of a bacterial origin for this disease. Though in some areas it appears to have been eliminated by improvements in hygiene and sanitation, the extra attention given to diet in those measures may have been the important factor. The great increase in its incidence in Vienna during and immediately after the World War suggests a deficiency disease. Working in Northern China, Preston Maxwell found the disease associated with a deficiency of the fat-soluble vitamin D in the diet: this vitamin is closely related to the metabolism of calcium (p. 147), and there was also, in many cases, a deficiency of calcium and phosphorus. Among the Chinese, a complete cure was effected by the administration of cod-liver oil and calcium lactate. Metabolic studies show a lack of absorption of calcium through the intestinal tract. There is no increase in the

excretion of endogenous calcium—the serum calcium is usually normal in amount, and the urine contains none. These findings appear to show an attempt to conserve endogenous calcium in view of the deficient absorption. It has been found that patients suffering from osteomalacia tolerate the administration of very large amounts of adrenalin, and this observation has been taken as evidence of hypofunction of the suprarenal glands. The improvement secured formerly in most women suffering from osteomalacia by the removal of the ovaries was regarded as evidence of hyperfunction of the ovaries. All those observations appear to show a most intimate relationship between endocrine function and dietary factors, but in the case of osteomalacia the most important point is Preston Maxwell's experience that a complete cure can be secured by treating the disease as a type of avitaminosis.

The lesions are usually localised in the vertebræ and pelvis, but may extend to the ribs and the clavicles. The bones become yellow or yellowish-brown in colour, soft and yielding in consistency, sometimes brittle. As the disease progresses, the spongy bones become so rarefied that only the outer layers remain intact, the inner layers being replaced by porous osteoid tissue. The bones become so soft that they yield to the stresses and strains produced by weight and pressure: in advanced cases they can be cut with a knife. At the end of pregnancy they become recalcified by the deposit of lime salts in the osteoid tissue, but a certain degree of permanent deformity of the vertebræ and pelvis results. The disease usually recurs with subsequent pregnancies, and the amount of pelvic deformity increases with each attack. These deformities are described in Chapter XXX (p. 516).

The disease commences with peculiar muscular paralyses, especially of the ilio-psoas, accompanied by contractures of the abductor muscles of the thighs. The patellar reflexes are increased. The patient complains of muscular pains in different parts of the body, and the affected bones become very sensitive to pressure. There is usually slight pyrexia, which, with the muscular pains, may suggest a rheumatic condition, but the location of tenderness in the bones rather than the joints is characteristic. Difficulty in diagnosis is only likely to arise when the condition occurs in a patient in a district where osteomalacia is seldom found. With the progress of the disease, actual bony deformities appear. There is usually an associated anæmia and some gastro-intestinal disturbance. The symptoms are relieved by the completion of the pregnancy. In most cases the earlier pregnancies are associated with very mild symptoms: there may be muscular paresis and vague rheumatic pains only. In later pregnancies the pains are worse, and locomotion is interfered with. Labour may be associated with severe dystocia. During the puerperium the bones again become hardened by the redeposit of calcium, but the shape is altered, even so much as to produce marked diminution in stature.

The treatment of this condition has already been referred to in the

discussion of its ætiology—viz., the administration of vitamin D and calcium.

DISTURBANCES OF THE EXCRETORY SYSTEM

Several of the disturbances of the excretory system—viz., *albuminuria*, *pre-eclamptic toxæmia*, *eclampsia*, *chronic nephritis*, and *symmetrical cortical necrosis*—have already been described in Chapter XI.

Pyelitis.—Infections of the upper urinary tract form fairly frequent complications of pregnancy. The infection involves the pelvis of the kidney and the upper portion of the ureter, but it extends very commonly into the substance of the kidney. It is therefore a more extensive lesion than that usually designated "*pyelitis*," and might be more correctly termed "*pyelonephritis*." This pyelitis occurs without there being any reason to believe that there has been an infection in this area before pregnancy commenced. There are, however, the additional cases in which an old tuberculous lesion of the kidney or a renal calculus is associated with the discharge of pus from the kidney during pregnancy.

The condition, in its acute form, occurs very commonly in young women, particularly during their first pregnancy. While it may appear from the fourth to the seventh month, its greatest frequency is during the fifth month. In a smaller number of cases it comes on in the puerperium. It may relapse during the current pregnancy, and not infrequently recurs in its chronic form in subsequent pregnancies. Chronic pyelitis is a common cause of discomfort and debility in multiparæ. In a series of 1000 patients admitted for antenatal treatment to a maternity hospital, urinary infection was found in 425 cases, and in 163 of these there was a definite pyelitis. The right kidney alone is affected in almost 50 per cent. of cases, the left kidney alone in 25 per cent., and both kidneys together in the remainder.

PATHOLOGY.—In the small number of cases which end fatally the pelvis of the kidney has been found distended, with its wall thickened. While the renal pelvis is distended, it is no more so than in mild infections, or indeed than in normal pregnancy, but the wall is much thickened and œdematous, and abscess formation occurs. The infection appears to spread up from the collecting tubules of the medulla, and involves the area of the cortex drained by these affected tubules. The ureter shows hypertrophy of the wall and dilatation of its lumen; but these changes are found in a large number of pregnant women, and are to be regarded rather as ætiological factors than as results of pyelitis (p. 59). The bladder is not very often involved in the inflammatory process, except where the original lesion has been a cystitis and the infection has spread upwards from there.

ÆTIOLOGY.—In almost all cases the infecting organism is the *Bacillus coli*. Rarely the staphylococcus, streptococcus or gonococcus

may be found. The usual channel of infection is the blood-stream—the organisms reach the circulation from the lower bowel as a result of some enteritic disturbance. There is frequently a history of some sharp upset of the habitual constipation before the attack of pyelitis. Under ordinary circumstances these organisms would be excreted freely by the kidneys, and escape without doing any damage to the walls of the urinary tract. The delay in the flow of urine, resulting from the changes in the urinary tract described below, allows a concentration of organisms, and as a result, the direct infection of the kidney pelvis.

In a small proportion of cases the pyelitis may be of the ascending type, arising from a *cystitis*. It has been shown experimentally that organisms can ascend from the bladder to the kidney through the lymphatics of the ureteric wall, even when the ureter has been ligated. It is unlikely that the kidney pelvis becomes invaded by direct passage of organisms through the lymphatics from the neighbouring bowel—at the level of the kidney the *Streptococcus faecalis* is the prevailing intestinal organism, and this organism hardly ever appears in a case of pyelitis.

The changes in the urinary tract are also important factors in the ætiology of pyelitis; in most women it is these changes, in association with an abnormal excretion of organisms into the urine, which cause pyelitis.

The ureters show hypertrophy of the wall throughout their whole length, but especially where they pass round the cervix to enter the bladder. Proliferation of the fibrous tissue and of the muscle bundles of the ureteric sheath is the chief cause of the thickening: there is also some œdema. The mucous membrane is thickened. In the juxtavesical portion of the ureter, the hypertrophy is so great that this part is converted into an almost rigid tube. The cause of this hypertrophy is difficult to determine; the extreme change in the pelvic portion of the ureter may be part of the general tissue change taking place in that region during pregnancy—the ureter there lies very close to the uterine wall. Even the base of the bladder may show muscular hypertrophy. On the other hand, it may be a protective mechanism to provide against pressure during the later months, and against trauma during labour.

Both ureters also show dilatation. In the left ureter the dilatation of the lumen is almost uniform throughout its whole length, but reaches its maximum just above the pelvic brim and tapers gradually down to the bladder. On the right side the picture is quite different; the dilatation extends only from the pelvic brim upwards, and the whole tube is much kinked and elongated. Just below the renal pelvis this kinking may be very acute, and cause a moderate degree of hydro-nephrosis. The right renal pelvis is, in the majority of cases, dilated to a much greater degree than the left. This is associated with the

fact that the right ureter lies further from the middle line than the left, at the level of the pelvic brim, and is therefore more liable to pressure. The dilatation, however, is found before there can be any pressure of the uterus on the pelvic brim. By the end of the second month of pregnancy, there is a definite loss of tone of ureteric muscle, due to corpus luteum activity (p. 59). This does not affect the flow of urine to any great extent until the fourth month, as until then there is no obstruction to the outflow of urine. At the fourth month, however, the uterus rests on the ureters at the pelvic brim, and stasis of urine results above that level. Owing to the poor tone of the ureter at this stage of pregnancy, even the slight pressure exerted by the soft uterus causes marked delay in excretion, particularly on the more exposed right side. In the case of neoplasms, especially ovarian cysts, similar in consistency, pressure occurs with the same type of deformity: the deformity, however, is usually very much less owing to the fact that there is no relaxation of muscle tone.

(CLINICAL COURSE.—There are two distinct clinical types, the acute and the chronic.

(a) *Acute Pyelitis*.—The patient, usually in the fifth month of her first pregnancy, is seized with an acute attack of abdominal pain, with great tenderness beneath the twelfth rib behind. The tenderness is more often on the right side, and at this stage there may be marked rigidity of the abdomen. The temperature rises to 103° or 104° , and there are frequently wide oscillations in the course of the twenty-four hours; there may be rigors. The pulse is rapid, 110 to 130, and the patient may remain acutely ill for several days, with repeated rigors, sickness, and vomiting. In addition to the very characteristic lumbar tenderness, the lower part of the ureter, palpated through the lateral fornix, is exquisitely tender. Pain is sometimes suddenly relieved by the passage of a large amount of infected urine. There may be bladder discomfort, with pain at the end of micturition, but this is not a constant feature.

(b) *Chronic Pyelitis*.—The patient experiences gradually increasing discomfort, with pain in her side or lumbar region, which may simulate an attack of subacute appendicitis or of pleurisy. There is general malaise, with loss of appetite. There is frequently sickness and vomiting, and chronic pyelitis should always be thought of when a woman in the later months of her pregnancy complains of persistent sickness. There may be a low pyrexia, though even a four-hourly chart may show only slight variation. The affected kidney is found to be tender on palpation, and there is definite tenderness on pressure in the lumbar region. In this type of case where there may be relatively little pain, the patient may nevertheless be very ill and toxic. This is due to the fact that the renal substance is extensively involved, but as the tone of the ureter and renal pelvis is poor, there is little ureteric spasm and consequently little pain.

In both clinical types the urine is diminished in amount and, at first, of high specific gravity. The concentration is rapidly reduced during treatment. It has a turbid appearance and is almost always acid in reaction. A trace of albumin is usually found. It contains pus cells, epithelial cells and red blood corpuscles: it often contains the *Bacillus coli* in pure culture. Occasionally there is a definite hæmaturia. A large amount of pus in the early stages is a favourable sign, as it indicates good drainage.

Improvement usually takes place in a few days under treatment. In the acute form the pain becomes less, the temperature falls and the pus diminishes in amount.

PROGNOSIS.—This form of pyelitis is seldom fatal to the mother: as a rule the condition clears up very satisfactorily under medical treatment. The *Bacillus coli* may be found in the urine for months after the acute symptoms have disappeared, and this explains the tendency to relapse. In a few cases the drainage stops and pyelonephrosis occurs. From this complication there may develop, but very rarely, a perinephric abscess, or a rupture into the peritoneal cavity, with general peritonitis. Sometimes an effusion into the pleural sac with a *coli* infection occurs. Rarely is there a massive invasion of the blood-stream with general septicæmia or pyæmia. This is more likely to occur with a streptococcal infection than with the usual *Bacillus coli* type.

Sometimes the recovery of the patient seems to be incompatible with the continuation of the pregnancy. A considerable amount of pus remains in the urine in spite of treatment, the temperature remains irregular, the appetite and digestion are greatly impaired and the patient loses weight. In such cases the pregnancy has to be terminated, and for this purpose puncture of the membranes is usually quite satisfactory (p. 734). The changes in the tissues may be so extensive as to leave the mother permanently handicapped.

The prognosis for the foetus is less favourable than for the mother, though the infection does not extend to the cavity of the uterus. The nutrition of the foetus is interfered with by the toxæmia of the mother, and abortion or premature labour may occur spontaneously. Chronic pyelitis may be an important factor in the causation of repeated premature labours or the birth of feeble children at full time.

DIAGNOSIS.—The clinical features of the pyelitis of pregnancy are very definite, especially in the acute form—high pyrexia, tenderness in the lumbar region, abdominal pain and pyuria. In establishing a differential diagnosis between pyelitis and appendicitis or gall-bladder conditions, this pyuria is of cardinal importance, and a catheter specimen should always be examined. The same factor is of great value in excluding pleurisy or pneumonia, though in these diseases the local signs are more definite. There may be greater difficulty with regard to cystitis and renal calculus. In the former, cystoscopic examination will be necessary if the history is not indicative: where signs of

an infection of the bladder wall are found, the ureters should not be catheterised. For stone, X-ray examination will be essential. Tuberculosis of the kidneys may be eliminated by the history and by bacteriological examination.

When pyelitis occurs in the puerperium, a differential diagnosis must be made from septic conditions of uterine origin.

TREATMENT.—The patient should be kept at rest in bed, lying on the unaffected side: she will probably be found to lie with her thighs well flexed. At first, especially where there is sickness, it is important to get the patient to drink large amounts of fluid—barley water or even plain water—to flush out the kidneys. As soon as the sickness is controlled a light diet should be prescribed, the nutritive value of which should be increased as quickly as possible. An adequate bowel movement should be secured daily.

For the relief of pain, warm applications such as fomentations are helpful, but in the acute phase, morphia may be necessary. The acid urine should be made alkaline by the administration of large doses of potassium citrate, 30 grams every four hours, and if possible continued through the night: a local sedative, such as tincture of hyoscyamus or of belladonna, may be added. Potassium causes sickness in some patients and may be replaced by bicarbonate of soda. The action of the alkalis is not fully understood, but the relief of symptoms is very striking. There can hardly be a definite bactericidal action, but the alkalinisation may relieve spasm and allow more free drainage. When fever has subsided and a copious excretion of urine continues, urinary antiseptics such as urotropine should be prescribed.

There have been several improvements in the treatment of urinary infections in recent years. A *ketogenic diet* is not suitable for pregnant women, not only because of the difficulty of preparing meals but also because such a diet is not well tolerated during pregnancy. *Mandelic acid* very often causes great discomfort and irritation in the acute phase of pyelitis, but gives good results in chronic cases. A great advance has been secured by the introduction of *sulphonamide therapy*. Formerly it was almost impossible to get the urine quite free from organisms before the end of pregnancy, even though the patient appeared well clinically. Even with such a small dose as 0.5 to 1 gram of a sulphonamide preparation, thrice daily, it is often possible to sterilise the urine in a case of acute pyelitis in four or five days. One great advantage of this rapid result is that it should lessen the damage to renal tissue which usually resulted from extensive abscess formation. Minor exacerbations frequently occur when the sulphonamide therapy is stopped, but readily respond to renewed administration. Cyanosis may appear during treatment, but need not be dangerous if the standard precautions against sulphur and sulphur compounds are observed. The associated anæmia should be treated by the administration of iron.

In cases where the response to alkalinisation of the urine is unsatis-

factory, fever persisting with great local discomfort, much help can be obtained by the catheterisation of the ureters and drainage of the renal pelvis by this route. The ureteric catheters may be left in position for three or four days, the renal pelvis being irrigated at intervals with boracic or weak acriflavine solution. Most cases with pyelonephrosis respond well to ureteric catheterisation, but where this is found impossible, nephrotomy may have to be carried out, drainage being established through the lumbar region. The urinary fistula thus established may close spontaneously afterwards; if the kidney tissue has been extensively destroyed, the remainder of the organ can be removed at the end of pregnancy.

Cystitis.—The tendency to frequency of micturition in pregnancy has been referred to in Chapter VII (p. 150). In addition to this very common disturbance there are more acute forms, in which frequency is combined with great pain on micturition. In such cases there is usually an old-standing cystitis, due to the *Bacillus coli* or the *gonococcus*, which has been stimulated to fresh activity by the vascularity of the parts. These cases should be treated with the greatest care because, by the ascent of the infection, they may give rise to a pyelitis. Some of them respond to alkalis, others to acid antiseptics, while a few require irrigation with the silver salts or with antiseptics, such as acriflavine.

The incontinence of urine and cystitis associated with incarceration of the retroverted gravid uterus have been described in Chapter XIV (p. 288).

The most severe forms of cystitis associated with pregnancy are found in the puerperium, especially after a protracted or difficult labour in which there has been stretching of or damage to the base of the bladder by the pressure of the foetal head.

Hæmaturia.—Hæmaturia may occur in pregnancy in association with eclampsia (p. 224) or subacute nephritis. It may also occur as a result of hæmorrhage from the kidney in a case of renal calculus, tubercular kidney or pyelitis. Again, it may be of vesical origin, caused by acute cystitis or great varicosity of the wall of the bladder. Occasionally the cause is a vesical calculus, in which case the patient may sometimes experience sharp attacks of pain which are relieved when she lies down, the pain being due to the pressure of the uterus or its contents on the bladder wall. In each case treatment should be directed to the cause of the hæmaturia.

Floating Kidney.—The right kidney is the one more commonly affected, but the discomfort which the patient usually suffers disappears as pregnancy advances, owing to the support given to the kidney by the expanding uterus. Cases have been reported where torsion of the pedicle has occurred, causing intense pain and simulating the pain of a renal calculus. Diagnosis may be difficult, but careful taxis usually relieves the condition and clears up the diagnosis.

After labour the sudden change in intra-abdominal pressure may allow the kidney to become very much displaced, and cause acute symptoms. Such patients should wear a well-fitting abdominal belt whenever they get out of bed.

In rare cases a congenital displacement of the kidney may be present, the organ resting on the pelvic brim and causing an obstruction during labour.

Calculus (Renal).—This condition may give rise to difficulty during pregnancy either from attacks of renal colic or from the re-establishment of an old pyelitis associated with the calculus. Where there are attacks of colic, the cause of which has been confirmed by X-ray examination, sedatives of the morphia group should be administered to relieve the pain. A series of these attacks may be followed by complete quiescence. Where there is an associated pyelitis, and when the attacks of colic and the pyuria are troublesome, it is usually advisable to have the stone removed and drainage established by a nephrotomy, without waiting for the end of pregnancy.

URETERIC CALCULUS.—While comparatively rare, ureteric calculi may cause severe pain during pregnancy. Diagnosis and treatment should be as described for renal calculi.

Pregnancy after the Removal of a Kidney.—Such cases should be watched with the greatest care. Many of them go through pregnancy undisturbed. In others the extra work proves too much for the kidney and albuminuria and cedema appear. When these signs of renal inefficiency occur and do not respond to very simple treatment by rest and dieting, the pregnancy should be terminated.

DISTURBANCES OF METABOLISM

Glycosuria.—The study of the physiology of pregnancy has shown that the discovery of sugar in the urine of a pregnant woman need not indicate that she is suffering from diabetes mellitus. The sugar may be lactose, which we now know to be practically a normal constituent of the urine in the later months of pregnancy. Even where glucose is present, the cause may be an alimentary glycosuria, which can be produced in almost 80 per cent. of pregnant women by increasing the amount of sugar ingested. Renal glycosuria may occur, with its characteristically small amount of sugar in the blood, and this form neither influences nor is influenced by pregnancy. In all these forms polyuria, thirst and wasting are absent, and the urine contains neither acetone nor diacetic acid.

In addition to these types, glycosuria may occur in the early months of pregnancy in cases of fairly severe hyperemesis gravidarum, and in a small number of cases in the last weeks of an otherwise normal pregnancy. In these cases the patient has had no indication of any diabetic lesion before her pregnancy, and the condition clears up without trace

as soon as the vomiting is brought under control in the former case, or at the end of pregnancy in the latter. These forms of glycosuria seem to be due to some disturbance of the related activities of the ductless glands. We know that the pituitary, the thyroid and the adrenal all increase in size during pregnancy, and the secretions of all these glands slightly lower sugar tolerance. Again, the cardinal symptoms of a true diabetes mellitus are absent—the patient has neither thirst, polyuria nor wasting. This functional glycosuria can be controlled by the elimination of sugars from the diet: starches may be continued.

DIABETES MELLITUS.—The association of pregnancy with diabetes mellitus is fairly rare, because diabetic women are very often sterile. This sterility is due to the atrophic changes which occur in the uterus and ovaries in this disease. While it was unusual a few years ago to find true diabetes in a primigravida, modern insulin therapy may alter this incidence. The disease was usually found in multiparæ, who had acquired the lesion after they started bearing children. While the diabetic condition has usually been recognised in these patients before the current pregnancy, there are cases in which the metabolic lesion seems to commence during the course of gestation. There are other cases in which there is evidently a true diabetes, especially in the later months, which occurs in successive pregnancies and disappears in the intervals.

Formerly the prognosis in pregnancy complicated by diabetes was very grave. In the pre-insulin days Williams collected a series of 66 cases, in which 27 per cent. died at the time of labour or within a fortnight afterwards, while a further 23 per cent. died within the next two years. These late deaths are often due to pulmonary tuberculosis, to which such patients are specially susceptible. In 15 per cent. of the cases, pregnancy ended in abortion or premature labour; less than 40 per cent. of the children born at full time were alive, and the survivors were often feeble. In a few cases the patient appears to do very well, especially in the second half of her pregnancy, even on ordinary diet, and it has been suggested that in these cases the foetal pancreas is able to supply the deficient secretion of the maternal organ; the glycosuria reappears after the pregnancy is over.

The prognosis is now much better, and in a recent series of 118 cases collected by Skipper the maternal mortality during pregnancy, labour and the puerperium was 9·3 per cent. and the additional deaths within two years amounted to 3·4 per cent. The total foetal mortality in this series, including abortions, still-births and neo-natal deaths, was 45 per cent.—still very high.

Clinical Course.—In diabetics during pregnancy the sugar content of the blood and of the urine is very high. The associated polyuria, thirst and wasting are very marked; the patient may experience great

discomfort from pruritus vulvæ. Hydramnios is a frequent complication, and the amniotic fluid in such cases usually contains sugar. As the foetal urine is free from sugar, this circumstance may be taken as a proof that in these cases at any rate the excessive amniotic fluid is a maternal transudate (p. 137). The foetus is sometimes of very large size, possibly as a result of the large amount of circulating carbohydrate available for its nutrition; in some cases there is foetal cedema. The large size of the foetus may be a cause of dystocia. The diabetic condition may become acute during pregnancy, when the patient sinks into coma.

Labour is a time of special danger, though in many cases it runs a normal course. Carbohydrates in an easily assimilated form should be given generously, together with an adequate amount of insulin, throughout the labour to provide energy. The course should be shortened as much as possible, by whatever means are appropriate, lest the muscular exertion increase the acidosis and precipitate the onset of coma. When obstetric interference is required, general anæsthetics should be avoided. Spinal anæsthesia is preferable, but if a general anæsthetic has to be resorted to, nitrous oxide with oxygen is the least harmful. The bladder may have to be emptied frequently during labour, owing to the rapid secretion of urine. Even at the end of labour, collapse, coma or sudden death is liable to occur. Pulmonary complications may occur in the puerperium, especially broncho-pneumonia; the special susceptibility of these patients to pulmonary tuberculosis has already been referred to. If puerperal infection appears, associated with trauma during labour, the prognosis is very grave, as there is the usual diabetic tendency to gangrenous processes. The mother should not be allowed to nurse her child, because of her general condition. The patient must be warned of the great danger likely to be associated with a subsequent pregnancy.

Treatment during Pregnancy.—When pregnancy occurs in a diabetic patient, or true diabetes is recognised during the course of pregnancy, very careful supervision must be exercised throughout the pregnancy. The patient must be put on to a carefully arranged diet, designed in terms of the blood and urinary findings. In some cases such a diet alone is sufficient; in most, insulin has to be administered throughout the pregnancy. The urine must be frequently examined, because the metabolic balance may vary with the progress of pregnancy. When there is evidence of progressive pancreatic disturbance shown by the development of ketosis or by a rise in the blood sugar, not easily controlled by an adequate increase in the insulin administered, the pregnancy should be terminated. Should this become necessary, it is almost certain that a subsequent pregnancy would lead to the same result. The best policy is therefore not only to terminate the pregnancy but also to sterilise the patient. For this purpose abdominal hysterotomy, with ligature or excision of the Fallopian tubes, performed

under spinal anæsthesia, is the best treatment. We have seen also that the prospects for the foetus are such that there is little justification for endangering the mother in the interests of the child. The special care necessary during labour has already been described.

DISTURBANCES OF THE ENDOCRINE GLANDS

So intimate is the relationship between the endocrine glands and the reproductive system that very few of the essential lesions of these glands are found in association with pregnancy. In cretinism, acromegaly, dystrophia adiposo-genitalis and in abnormal conditions of the thymus gland, the patients are generally sterile. Even in exophthalmic goitre and Addison's disease sterility is characteristic of the later stages.

Thyroid Gland.--During a normal pregnancy the thyroid gland enlarges, sometimes to a considerable degree, and returns to its normal size during the puerperium. In some cases, however, pregnancy seems to be the starting-point of a permanent goitre. Where the goitre is present before the occurrence of pregnancy it may undergo a very rapid increase in size and cause respiratory difficulty. During labour a still further increase occurs and this may cause such difficulty as to require tracheotomy.

Thyrotoxicosis.--Women with exophthalmic goitre often suffer from amenorrhœa and sterility associated with atrophy of the uterus and ovaries. In a certain number of cases pregnancy may occur before this stage. In such an event the symptoms of exophthalmic goitre are aggravated, but pregnancy usually goes on to term; the more acute symptoms are often relieved at the end of pregnancy. In some cases pregnancy seems to ameliorate the symptoms, perhaps because the foetus takes up the excessive secretion. In those cases in which the thyroid lesion is associated with a persistent thymus, the prognosis is specially grave. The foetus is usually healthy, though it may be born with a goitre.

There are a certain number of cases in which cardiac symptoms become distressing in the later months. In such cases induction of premature labour may be justified when there is not an immediate response to treatment by rest and sedatives. It is practically only in these cases that abortion or premature labour occurs. Such patients may cause considerable anxiety during labour, owing to the risk of cardiac failure. Treatment should be carried out as in cardiac cases (p. 244).

During the course of pregnancy the exophthalmic condition should be treated as in the non-pregnant state. Most patients respond readily to the administration of iodine (Lugol's solution). Partial ligature and partial removal of the thyroid gland have been carried out in some cases with satisfactory results and without disturbing the pregnancy.

These women do not make good nursing mothers. This may be due to the large amount of thyroid secretion in the milk.

Tetany.—Tetany is a rare complication of pregnancy, though the tetany of pregnancy is the commonest form of adult tetany. In Vienna, a city in which tetany is specially frequent, it was found in only nine out of 30,000 pregnant women. It comes on in the second half of pregnancy and may recur in subsequent pregnancies: it may not appear until the period of lactation.

The patients exhibit all the classical symptoms: carpo-pedal spasm, irritability of the facial muscles, production of the carpal spasm by pressure over the brachial plexus, paræsthesiæ and increased reaction of the muscles to galvanic and faradic stimulation. Trophic disturbances of the epidermal structures appear—loosening of the finger-nails, hair and teeth, and cataract formation may appear in the eyes. All these symptoms usually appear in an aggravated form in pregnant women. The contractures seem to be excited by uterine contractions. The first signs of the onset of the disease may take the form of paræsthesiæ, muscular stiffness and weakness, and pains in the fingers while sewing. The course of pregnancy is not interrupted spontaneously and labour is usually normal. The foetus is often macerated or may die in convulsions. The symptoms may become so acute, and interfere so much with the patient's nutrition and her rest, that the pregnancy has to be terminated. Tetany should be regarded as a serious complication, and severe cases may end fatally.

Ætiology.—The relationship of tetany to disturbances of the parathyroid glands is now established, and the changes which occur in these glands during pregnancy have already been described (p. 153). In some cases of the tetany of pregnancy which have gone to post-mortem examination, the parathyroids have been found to be in a condition of cystic or fatty degeneration. Though malnutrition may play some part in the causation of tetany in pregnancy, there is good experimental and histological evidence for associating the condition with a disturbance of the function of the parathyroid glands.

Treatment.—When the symptoms are very acute, immediate steps must be taken to arrest the spasms by the use of such drugs as morphia, chloral, hyoscine or bromides. In extreme cases chloroform may be necessary. The permanent treatment depends on the ætiological factors which have been mentioned above. The extract of the parathyroid glands should be administered either alone or with thyroid extract. In addition, large doses of calcium in the form of calcium chloride, 30 to 60 grains daily, should be given together with vitamin D. The cases in which pregnancy has to be terminated have been referred to above.

Addison's Disease.—In well-established cases of this disease sterility is the rule, but pregnancy may occur in the early stages. The lesion of the suprarenal gland is here very often tubercular, and

pregnancy has generally an unfavourable influence on tubercular lesions (p. 278). As might be expected, therefore, the effect of pregnancy on Addison's disease is unfavourable. In 12 recorded cases, 5 did not survive the pregnancy. In cases where the general symptoms become very much exaggerated the pregnancy should be terminated.

CHAPTER XIII

THE RELATIONSHIP OF INFECTIOUS DISEASES TO PREGNANCY

INTRODUCTION

THE course of pregnancy may be complicated by the onset of one of the acute infective diseases, or by an infective disease of a more chronic type; on the other hand, a chronic infective disease may be complicated by the occurrence of pregnancy. The onset of the acute infective type is a very serious complication, because there is here not only the acute toxæmia due to the infective disease but also the severe mechanical strain on the maternal organs, particularly in infections of the respiratory tract. In the chronic forms, the harmful effects are mainly due to the toxæmic effects. Those infective conditions, the lesions of which attack the reproductive organs themselves during pregnancy, will be considered after the more general infectious diseases have been disposed of.

ACUTE GENERAL INFECTIOUS DISEASES

Those diseases in pregnancy tend to produce effects (*a*) on the maternal tissues, and (*b*) on the course of pregnancy. In the mother, there are the dangers incident to hyperpyrexia, and to the accompanying nephritis. The toxæmic complication has been referred to. The particular infectious diseases tend to assume their hæmorrhagic forms, the prognosis in which is always serious. In those diseases which affect the respiration organs the large size of the uterus in the later months adds to the respiratory embarrassment by limiting the range of the diaphragm. Grave danger is experienced when labour or abortion sets in, as the exhausted women are unable to stand much strain. Collapse may occur in the third stage of labour and there is the later danger of such patients becoming easy victims to sepsis.

The course of pregnancy is usually interrupted. The hæmorrhagic tendency referred to above often causes hæmorrhages in the placenta, sufficient to impair the vitality and cause the death of the fœtus. There is not only the risk of placental hæmorrhages but also the adverse effect of hyperpyrexia on the fœtus. The toxins of the maternal infection by their passage through the placenta may cause

the death of the foetus : the infective agent in most of the exanthemata and the organisms in several of the bacterial diseases can be transmitted to the foetus.

Smallpox.—Here the mortality is greater in pregnant than in non-pregnant women (36 per cent. as against 25 per cent.), as the disease is very liable to assume the confluent and hæmorrhagic forms. When this complication occurs, abortion or premature labour usually follows. When the lesions remain discrete, the prognosis for the mother and the pregnancy is better. The foetus may become infected through the placenta and be born with smallpox lesions present : in binovular twin pregnancy one child may be born with smallpox lesions while the other shows no sign of the disease. Mauriceau, the French obstetrician, was born pock-marked.

Vaccination of the mother protects the mother only, and probably conveys no immunity to the child *in utero*. This is particularly the case when vaccination is performed during the course of the disease in a pregnant woman, as the child may become infected during delivery or afterwards. Some clinicians have stated that where a mother has been vaccinated during pregnancy, the infant proves refractory to vaccination after birth. This experience has not been confirmed in recent local epidemics. Vaccination in pregnant women does not tend to cause abortion or premature labour.

Chickenpox.—Varicella has no influence on pregnancy or labour. The child may be born covered with the rash.

Scarlet Fever.—While true scarlet fever is a rare complication of pregnancy, forms of erythema, which resemble it very closely, occur as a result of septic conditions, particularly in the puerperium. These septic rashes were formerly so commonly mistaken for scarlet fever that statistics were published to show that pregnancy conferred immunity to scarlet fever. These figures were obtained by showing the so-called scarlet fever of the puerperium as true scarlatina, occurring apart from pregnancy. A popular legacy of this mistake persists in the horror which women have of carrying a scarlatinal infection to a puerperal woman. The hæmolytic streptococcus which causes scarlet fever is closely related to the hæmolytic streptococcus so often found in puerperal sepsis. When scarlet fever occurs in a pregnant woman, the greatest care must be taken to avoid the transference of hæmolytic streptococci from the nose, throat, or other parts to the genital tract.

When true scarlet fever does occur in pregnancy, it usually causes abortion. The cause of the death of the ovum may be either hyperpyrexia or toxæmia. In very rare instances the child has shown a scarlatinal rash at birth.

Measles.—Measles is an infrequent but a dangerous complication, as it usually is in adults. The hæmorrhagic form is associated with great danger to the mother and the foetus. In a series of 30 cases, gestation was interrupted in 55 per cent. and death occurred in 15

per cent. Sepsis is a grave danger in the puerperium. The children may show the characteristic lesions of the disease at birth.

Cholera.—Though pregnant women are not specially prone to cholera, they succumb very readily to the disease. The Hamburg epidemic of 1892 showed a 57 per cent. mortality in pregnant women. Abortion or premature labour occurred in over 50 per cent. of cases, associated with hæmorrhagic changes in the placenta and endometrium. Some cases have been recorded of direct transmission to the child. In most cases the disease causes uterine contractions, from the action of some toxin circulating in the blood.

Enteric Fever.—This is a dangerous complication of pregnancy for both mother and child. Abortion and premature labour occur in 60 per cent. of cases, and a large number of the live-born children die soon after birth.

The foetal blood gives the Widal reaction, particularly in the later months, and the bacillus may be found in the foetal tissues. Ulceration of Peyer's patches may be found in the foetal intestine. Foetal death probably occurs as a result of a typhoid septicæmia. The maternal mortality is higher than in uncomplicated enteric fever.

In the puerperium, the differential diagnosis of enteric fever from puerperal septicæmia is most important. In doubtful cases the Widal reaction should always be tested, though the rose-spots, the slow pulse and the character of the stools are valuable guides.

Malaria.—Mild cases have little effect on gestation, but in severe cases, especially where the parasite is of the malignant tertian type, premature labour and foetal death may occur. Even in the malignant type, the parasite rarely reaches the foetal circulation: the disturbance of the pregnancy results from high pyrexia, cachexia, and possibly the invasion of placental tissue by the parasite. In a series of 56 cases of malaria in pregnant women in Central Africa, the parasite was found in the tissue of the placenta in 74 per cent., but in the blood of the umbilical cord in only 6 per cent., and in the blood of the child in only 3·6 per cent. Even though congenital infection with malaria is possible, it does not appear to exercise an adverse influence on the child: the parasites soon disappear from the blood.

An exacerbation of latent malaria may occur during pregnancy or labour: such an attack occurring in the puerperium may call for a differential diagnosis from puerperal sepsis. There seems to be a tendency to hæmorrhage in labour and the puerperium. Quinine may be given to pregnant women without risk, as the oxytocic properties of the drug seem to be in abeyance in such conditions.

Erysipelas and Sepsis.—Erysipelas is a most dangerous complication of pregnancy, as the causal hæmolytic streptococci may spread to the blood-stream, pass through the placenta and produce foetal septicæmia and foetal death. Extraordinary precautions must be taken by the patient herself, and by the nurses and doctors in attend-

ance to prevent the transference of the streptococci from the local lesion to the genital tract (p. 401). The necessarily infected environment of her home is a serious danger to the woman in labour and during the puerperium. The most strict isolation and segregation of such patients is necessary in the interests of other pregnant women.

Any bacterial infection of the mother, such as tonsillitis, mastoiditis, or a cellulitis, has a worse prognosis in pregnancy, labour, or the puerperium, because of the same dangers as have just been described for erysipelas. The association of tonsillitis with hæmolytic streptococci makes it particularly dangerous. *Tetanus* and *anthrax* should be included among the grave dangers to pregnant women—they are serious diseases under any circumstances. The anthrax bacillus passes into the fetal tissues. All these infective diseases should be treated by standard methods, without reference to the pregnancy.

Influenza.—The effect of influenza on pregnancy varies very much with the virulence of the particular epidemic, and with the tendency in such epidemic forms to pneumonic complications. The ordinary pandemic form has not such grave effects on pregnancy as the others. The gastro-intestinal and nervous forms affect pregnancy little, though they may cause difficulty in diagnosis from hyperemesis gravidarum or eclampsia. The acute respiratory form is the most serious type, particularly when it occurs in the later months of pregnancy: the maternal mortality has been found to be about 25 per cent., with an increase to 50 per cent. in those cases in which pneumonia developed. Influenza of this type commonly causes premature labour, often preceded by considerable uterine hæmorrhage: the frequency of spontaneous interruption of pregnancy has been found to be exactly the same as the mortality rate, 25 per cent. over all respiratory cases with an increase to 50 per cent. when pneumonia developed. In the fatal cases spontaneous termination of pregnancy occurred in over 60 per cent. before the death of the mother. The profound toxæmia causes rapid exhaustion of the mother, who stands the strain of labour very badly. There is seldom any advantage in inducing labour—only extreme cyanosis and dyspnoea would justify this step. The method should be by puncture of the membranes (p. 734). The intrapartum care of the patient should be on the same lines as for cardiac cases (p. 242). These women are specially liable to puerperal infections owing to their lowered resistance. The foetus is rarely affected except in so far as its chance of life is prejudiced by abortion or premature labour.

Pneumonia.—The maternal mortality in pregnancy complicated by pneumonia is high because of the tendency to premature labour or abortion. Pregnancy is interrupted in over 50 per cent. of cases, particularly in the later months. Respiratory difficulty in pneumonia is great, and the onset of labour increases the strain. Labour should not be induced, because the maternal mortality has been found much

higher when labour was induced than when treatment was expectant. During pregnancy the pneumococcus may be transmitted through the placenta to the foetus : when pneumonia develops towards the end of pregnancy or early in the puerperium, the bacteria may be carried by the blood-stream to the uterus and give rise to puerperal infection.

The same precautions should be taken in labour as are described for cardiac cases (p. 242).

CHRONIC INFECTIOUS DISEASES COMPLICATED BY PREGNANCY

Tuberculosis.—The relationship of pregnancy to pulmonary tuberculosis has received a great deal of attention in recent years : the investigation of large series of cases tends to show that pregnancy has not such an adverse influence as was formerly believed. In Sweden, a comparison of the clinical records of about 350 tuberculous women who had recently gone through pregnancy, with those of a slightly larger number of tuberculous women who had not been pregnant showed that at the end of two years the mortality rate in the two groups was the same, and depended essentially on the severity of the pulmonary lesion. An investigation in Johns Hopkins Hospital showed that the death rate was higher at the end of a year or more in those tuberculous women in whom abortion had been induced than in those in whom pregnancy had been allowed to continue. The prognosis depends upon the degree of activity and the extent of the tuberculous process at the beginning of pregnancy.

Many women suffering from pulmonary tuberculosis appear to be improved in health during pregnancy—they put on weight and look well. At the end of pregnancy, however, the tuberculous lesion may extend rapidly, leading to death from tuberculous broncho-pneumonia in a few weeks or months. The improvement during pregnancy is associated with the restricted movement of the diaphragm and of the lungs themselves, resulting from the large size of the uterus in the later months : the effect corresponds to that of an artificial pneumothorax. The restoration of free movement of the lungs after labour may allow the inspiration of tuberculous material into healthy portions of lung, with rapid extension of the disease.

In some women a quiescent pulmonary lesion may show signs of activity during pregnancy, or an active lesion show great acceleration. Tuberculous laryngitis may appear as a complication and the prognosis in such cases is very grave. Even when the patient's health is poor during pregnancy, tuberculosis does not appear to produce abortion or premature labour.

While tuberculous lesions in the placenta are rare, and particularly so in the foetal portion, the bacilli do make their way through the

placenta. They have been identified in the blood of the umbilical vein and in the foetal liver. The most advanced tuberculous lesions occur in the foetal liver. Congenital tuberculosis, therefore, does occur as a result of placental transmission. When we consider the large number of tuberculous women who become pregnant, and the small number of cases recorded in which the disease has been conveyed directly to the foetus, we must regard the latter occurrence as exceptional. In the majority of cases the child of a tubercular mother is born with simply a tendency to tuberculosis. This should be combated by placing the child in the most favourable hygienic conditions. Suckling by the mother should never be allowed.

Early Months.—The prognosis for the mother depends on the activity of the tuberculous lesions. If they have been of long standing and been dormant for a long time, the mother may go through pregnancy unaffected; but, even in these cases, the strain of pregnancy sometimes stirs up old foci. The prognosis in the more active lesions is so grave that some physicians recommend the termination of pregnancy as soon as a diagnosis of active tuberculosis is made. In some German clinics, not only is the pregnancy terminated, but the mother is immediately sterilised by a major operation. Such radical treatment is seldom justified. Induction of abortion may be considered in a first pregnancy in a woman with an active lesion, so that she may have an opportunity of combating the disease without the handicap of pregnancy. She should be advised against incurring the risk of conception until the tuberculous lesions have been quiescent for a considerable time. In other cases of early pregnancy complicated by tuberculosis, there is rarely any justification for procuring abortion, unless some such dangerous complication as laryngeal tuberculosis occurs. No case should have the pregnancy terminated until a most careful review has been carried out by a physician with special experience in tuberculous conditions. Bacteriological and radiological evidence are essential. In all cases in which a conservative policy is adopted, sanatorium treatment may be most helpful.

The Later Months.—In tuberculous lesions manifesting signs of activity in the later months of pregnancy, the case should be treated expectantly, unless the mother does not seem likely to live until the end of pregnancy. Interference may then be carried out in the interests of the child, even by Cæsarean section carried out under spinal or local anæsthesia. In the ordinary case, the induction of premature labour has just as serious effects on the mother as labour at term, while the chances for the child are less favourable. The course of the second stage of labour should be shortened, as in severe cardiac cases (p. 242).

General Considerations.—Whether a tuberculous woman, who asks advice, should be recommended to marry or not, or to incur the risk of pregnancy, is a very difficult question. In all cases there is a risk ;

but much will depend on the resistance to the disease which the patient has been able to acquire. When pregnancy does occur in such patients, its course should be most carefully watched.

Syphilis.—Syphilis is a most important complication of pregnancy. In view of the frequency with which disease and death of the ovum occur in such cases, its effect on the foetus is considered fully in Chapter XV (p. 316). The consideration of this disease in women apart from pregnancy is dealt with in Chapter XLV (p. 868).

When infection occurs during pregnancy, the vascularity of the parts allows the primary sore to assume larger proportions than in the non-pregnant condition: on the other hand the primary lesion may escape detection. The secondary lesions may occur as large elevated areas, sometimes with extensive ulceration and destruction of tissue in the genitalia. The secondary lesions, however, may also be so inconspicuous as to escape detection. The fact that a woman might give birth to a syphilitic child, without showing any evidence of syphilis herself was accepted as evidence that a woman might bear a syphilitic child, the result of paternal syphilis, without acquiring the disease herself. This view has now been discarded, and such patients are regarded as syphilitic.

The relative dangers to the foetus in the pre-pregnant, the conceptional, and in those infections where inoculation occurs during pregnancy, are considered in Chapter XV (p. 316). The most favourable prognosis for the child is where the pre-existing lesion has been thoroughly treated, or where the lesion occurs very late in pregnancy. Prognosis in the other cases is improved by thorough treatment.

Treatment.—In the case of every patient in whom an active syphilitic condition is present, as may be indicated by an actual local lesion, or by the history of her previous pregnancies and a positive Wassermann reaction, thorough treatment should be commenced as soon as ever either the syphilitic lesion or the pregnancy is diagnosed. Even in cases where a syphilitic woman has had a course of treatment before pregnancy occurred, she should always be advised to return for a further course of injections as soon as she finds herself pregnant.

The most satisfactory treatment is the intravenous administration of drugs of the arseno-benzol type, such as salvarsan or novarsenobillon, supplemented by the intramuscular injection of heavy metals, either mercury or bismuth. The addition of the mercury or bismuth increases the prospects of a healthy child from 78 to 93 per cent. Where treatment can be started in the early months, the administration of 0.3 gm. of novarsenobillon should be followed by weekly injections of 0.45 gm. up to a total of eight or ten injections. This should be followed by weekly intramuscular injections of mercury or bismuth for one month, combined with the administration of potassium iodide by mouth. During the four weeks before term, the patient should again have a weekly injection of novarsenobillon. Where the patient does not come

under treatment until late in pregnancy, the administration of the arsenical preparation and of the heavy metal should be carried out in conjunction during the same period, but the former drug is the more important. The drugs are transmitted to the foetus through the placenta, and the condition of the maternal tissues during pregnancy seems to allow the drugs to be peculiarly effective on those tissues. The possibility of damage to the kidneys and liver of the mother should always be guarded against: the urine should be frequently examined for the presence of albumen, and the first sign of icterus noted. Treatment on these lines has resulted in many cases in the birth of a healthy infant with a negative Wassermann reaction.

If the child of a syphilitic mother shows stigmata at birth or makes poor progress, treatment by grey powders and mercurial inunction should be commenced forthwith. Only the mother herself should be allowed to nurse her child. She may do so with impunity to herself when she shows no syphilitic lesion, whereas the child may infect a wet-nurse.

Prophylactic Treatment.—Consideration has sometimes to be given as to how one can obviate the dangers to the ovum, caused by syphilis, in a future pregnancy; or at what interval, after a syphilitic infection, the risk of conception may be incurred. In such cases both the husband and wife have to be considered. The period which must elapse before a syphilitic man, after a course of treatment, may be considered free from the disease from the point of view of infecting his wife, has been very much reduced by thorough modern treatment.

When the question of pregnancy is considered, existing lesions should be thoroughly treated in both parties. When repeated examinations have given a negative Wassermann reaction, pregnancy may go on to a satisfactory conclusion; but during its course the mother should have a course of intravenous injections such as is indicated above.

LOCAL INFECTIVE LESIONS IN PREGNANCY

The pregnant woman may suffer from any of the ordinary inflammatory lesions of the vulva and its associated structures and of the vagina. The causes of infection are the same as in the non-pregnant woman, but the lesions may be aggravated by the increased vascularity, and particularly by the varicosities, of these parts which occur during pregnancy. Vulvitis, Bartholinitis and Vaginitis are described in Chapters XLV and XLVI, and their importance in pregnancy depends on the greater vulnerability of these tissues at that time. The most common infecting agent in these tissues is the gonococcus; and the special forms of gonorrhœal infection in pregnancy require consideration in this section.

Gonorrhœa.—During the course of pregnancy, an acute gonorrhœal

infection may give rise to considerable disturbance. Whereas in non-pregnant women the effects of the organism are most marked in the urethra, the vulvar glands and the cervix, the congested condition of the vagina in pregnancy enables the organism to penetrate the vaginal and vulvar epithelium very deeply. There is profuse secretion of greenish-yellow pus; the vulva is red, sometimes ulcerated, and covered with gonorrhoeal warts; the vagina is thick and granular, and bleeds very easily; the cervix is swollen and its canal filled with purulent secretion in which the organisms abound.

In the chronic form the organism has penetrated into all the characteristic orifices in the genital tract. Both forms, acute and chronic, may spread to the uterine cavity during the early months of pregnancy, and cause an inflammatory lesion of the decidual tissue, producing abortion. Until the end of the third month, the ovum does not occupy the whole uterine cavity (p. 79) and infection may spread to the decidua and even to the Fallopian tubes: during the last six months, the uterine cavity is obliterated and direct extension to the decidua or tubes does not occur. So long as the cervical canal remains occluded by the operculum (p. 123) bacteria seldom find entrance to the uterine cavity.

The gravest danger, both in the acute and the chronic types, is in the puerperium. The chief danger to the child is the danger of gonorrhoeal ophthalmia, which may be acquired during its passage down the genital canal or by transmitted infection soon after birth. In the mother, while the bulk of the organisms have not been able to penetrate beyond the cervix during pregnancy, the occurrence of labour, with the alterations in the cervix, allows a free entry of the organisms into the cavity of the uterus. A puerperal inflammatory process may result, and may lead to salpingitis and oophoritis, or to pelvic peritonitis. These complications are considered with the infections of the reproductive organs.

TREATMENT.—Treatment should be instituted without delay during pregnancy. The external lesions should be dealt with—abscesses of Bartholin's glands should be aspirated or incised, and gonorrhoeal warts thoroughly treated. Good results in the treatment of the warts may be obtained by the repeated application to the area of lint soaked with 1 per cent. lactic acid. The most satisfactory results are obtained by keeping the patient in bed, with nursing services, throughout the early stages of treatment.

The introduction of the sulphonamides has revolutionised the treatment of gonorrhoea. It was suggested that M & B 693 favoured abortion, but this has not been confirmed. At the moment sulphathiazole (M & B 760) appears to be the best preparation in pregnancy. For details of treatment see Chapter XLV (p. 871).

It may be advisable to carry out this treatment on the first occasion under anaesthesia to allow an accurate examination. This

daily application should be continued until the discharge stops, but vaginal douching should be continued at least once daily. Throughout the rest of the pregnancy the application of silver salt or other antiseptic should be carried out once weekly.

When the condition is first recognised in labour, or when an old lesion is known to persist, the vagina should be swabbed dry and painted with a solution of 1 in 500 acriflavine. Examinations and manipulations should be reduced to a minimum. When labour is prolonged, the vagina should be douched every four hours with a mild antiseptic solution such as 1 in 4000 acriflavine.

During the puerperium the patient should be made to sit up as soon as possible, to promote drainage. Vaginal douches should not be used because of the danger of carrying organisms into the uterine cavity.

Reference should be made to Chapter XLV, where the signs, symptoms and treatment of gonorrhœa in women, apart from pregnancy, are described (p. 868).

Vaginal Parasites.—The increased vascularity of the cervix and vaginal walls during pregnancy, with the associated increase in the amount of secretion in the vaginal canal, produces conditions favourable to the parasites which tend to appear in that region. On the other hand there are special conditions (p. 641) which protect the canal against bacterial infection.

During the routine examination of vaginal discharges at antenatal clinics, as many as 20 per cent. of the patients may be found to have the motile parasite *trichomonas vaginalis* present. Not all these patients have associated symptoms, but a considerable number do complain of great local irritation, with the presence of a very copious greenish, slightly frothy discharge. Treatment should be carried out in all cases in which the parasite is found: those who have little discomfort at the time of examination may develop this later. This parasite is most resistant to treatment and a great variety of antiseptics, including picric acid and arsenical preparations, have been employed (p. 798).

In antenatal clinics many patients may be found to have *oidium albicans* present in the vagina. The moist mucous membrane whose cells have a rich content of glycogen favours the incidence of *thrush*¹ which is further favoured by the fact that 20 to 30 per cent. of pregnant women manifest a glycosuria (generally only temporary). There is very great local discomfort, and there may be an associated œdema of the external genitalia. Treatment should be carried out as soon as the parasite is identified. Very satisfactory results have been obtained by the daily application to the vaginal walls of gentian violet in a 2 per cent. aqueous solution. The vagina should be stretched out with a speculum and then filled with the solution, which is allowed to remain in contact with the walls for fifteen minutes. As the discharge diminishes the frequency of the application is reduced.

¹ Glen Liston and Chisholm. *Edin. Med. Jour.*, July 1941, pp. 433, 451.

Two special varieties of vaginitis—*granular* and *emphysematous* vaginitis—are referred to elsewhere (p. 897). They are occasionally encountered in pregnant women.

Endometritis Decidue.—*Acute Endometritis.*—Acute inflammatory lesions of the decidual endometrium may occur in association with the acute infectious diseases which complicate pregnancy (p. 281). They may result from infection following criminal abortion, or be the result of an acute gonorrhœal infection in the early months where the organisms have penetrated through the cervix. The effect of this condition is usually to cause abortion: so common is

this that it may be difficult to decide whether the infection preceded or was merely coincident with the abortion. Where the course of an abortion is slow, secondary infection of the decidua may occur as a complication.

Such a cause should be suspected whenever a patient complains of a sensation of weight in the lower abdomen associated with a slightly blood-stained or dirty-brown discharge, especially when there is a history of gonorrhœal infection or of repeated abortions.

This condition is not amenable to treatment during pregnancy. The cause should be investigated and appropriate treatment carried out after abortion or at the end of pregnancy.

Chronic Decidual Endometritis.—The care which must be exercised in establishing from the histological picture of the endometrium, a diagnosis of infective endometritis of a chronic type, becomes still greater when the endometrium undergoes decidual changes during pregnancy. The decidua may be found very much thickened, hyperæmic, with small local hæmorrhages, and infiltrated with leucocytes, which in some places are concentrated in densely packed masses resembling microscopical abscesses. This picture is found in some cases of abortion, and is frequently associated with a history of puerperal infection in a previous pregnancy. The condition has been described as *hypertrophic decidual endometritis*, and there appears to be little doubt about its infective origin.



With permission from "Midwifery by Ten Teachers."

FIG. 85.—Glandular Decidual "Endometritis" with Multiple Cyst Formation.

In other cases there is marked hyperplasia of the glands which continue to secrete mucus freely. There is incomplete fusion between the decidua capsularis and the decidua vera, and the secretion escapes from the uterus as watery fluid, either constantly or intermittently. Occasionally, small cysts are formed by retention of secretion within the glands and the rupture of these cysts allows the escape of sudden small gushes of fluid (Fig. 85). This watery discharge constitutes the clinical condition described as *hydrorrhœa gravidarum*, which should not be confused with premature rupture of the membranes, though the differential diagnosis may be difficult (p. 506). The histological picture of this *glandular decidual endometritis* is not that of an inflammatory lesion. Glandular hypertrophy of the endometrium is almost always due to excessive hormonal stimulation (p. 788), and this abnormality in the development of the decidua is more likely to be due to an endocrine disturbance than to local inflammatory changes. In this condition there is also a tendency to abortion, as a large amount of the blood supply to the foetus may be diverted to nourish this hypertrophied endometrium.

In a third type, the decidua shows atrophic changes early in pregnancy and is described as *atrophic decidual endometritis*. This variation may cause abortion, or, where the pregnancy continues, allow abnormal adherence of the placenta, as in *placenta accreta* (p. 555).

Chronic Subinvolution (*Chronic Metritis*).—This condition practically always originates from a previous pregnancy and is not amenable to treatment during pregnancy. Abortion frequently occurs. The ætiology and treatment of metritis are dealt with in Chapter XLVII.

Peri-uterine Inflammation.—Where old inflammatory adhesions surround the uterus, pregnancy may cause considerable discomfort owing to the stretching of these adhesions. An old infective focus may be stirred up and abscess formation result, accompanied by the signs of pelvic peritonitis. The diagnosis may be very difficult, and treatment must be carried out as for a pelvic inflammatory lesion without regard to the pregnancy.

CHAPTER XIV

DISTURBANCES OF THE REPRODUCTIVE SYSTEM COMPLICATING PREGNANCY

Displacements of the Uterus: Antelexion—Retroflexion—Lateroflexion—Prolapse; Acute Œdema of the Cervix; Hypertrophy of the Cervix; Malformations of Uterus; Hernia of Uterus; Tumours complicating Pregnancy.

DISPLACEMENTS OF THE UTERUS

ANTEFLEXION.—EARLY WEEKS.—An increase in the normal anteversion and antelexion of the uterus is a characteristic feature of the early weeks of pregnancy (p. 124). Antelexion may be very marked: and it is claimed by some to be occasion-

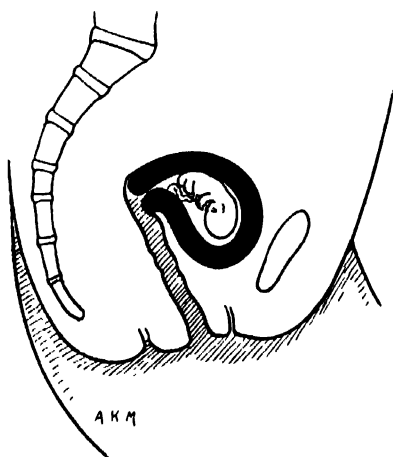


FIG. 86.—Antelexion of Gravid Uterus.

ally the cause of excessive vomiting of pregnancy (*hyperemesis gravidarum*). This is very doubtful; in all probability, if benefit follows local treatment, it is due to "suggestion" (p. 199).

Diagnosis.—The uterus feels large, globular and soft, and can be readily palpated between the fingers in the anterior fornix and the other hand placed over the abdomen. It may resemble a fibroid tumour in the anterior wall of the uterus, or less closely other tumours situated in the utero-vesical pouch and palpable

through the anterior fornix. It never becomes incarcerated; the exaggerated antelexion disappears as the body of the uterus rises out of the pelvis.

Treatment.—Treatment is unnecessary unless one is convinced that the antelexion is aggravating the morning sickness. There is no pessary suitable for this displacement, consequently if the fundus has to be "propped up" this can only be achieved by placing gauze in the anterior fornix.

LATER MONTHS.—If the pelvis is contracted or the abdominal walls are weak, the greatly distended uterus may project unduly in front and cause the patient a considerable amount of discomfort.

This condition is generally termed "pendulous abdomen." A pendulous abdomen in a woman of small stature should always lead one to suspect pelvic disproportion (p. 522). Where the cause is a weak abdominal wall and the ante flexion is extreme there may be an actual interference with the engagement of the presenting part, and when labour supervenes, delay in its progress. In all cases of this nature immediate benefit follows the application of an abdominal binder or belt, which has the effect of bringing the axis of the uterus into line with the axis of the pelvic brim.

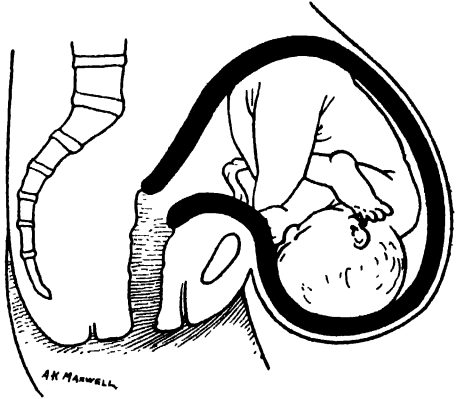


FIG. 87.—Pendulous Abdomen.

Occasionally, where the operation of vaginal fixation or abdominal fixation has been performed for backward displacement, considerable distortion of the uterus may occur. As a complication of labour, it is considered later (p. 548).

Retroversion and Retroflexion.—The ætiology of these displacements is fully considered in the gynecological section (p. 850). Here we are concerned with them in so far as they affect pregnancy. In the pregnant woman it is hardly necessary to distinguish between retroversion and retroflexion; both are associated with the same symptoms should the gravid fundus become *incarcerated* in the pelvis.

Very occasionally acute retro-displacement may occur during pregnancy from a fall, or if tumours of ovary or uterus push the fundus backwards. Speaking generally, however, the condition arises where pregnancy occurs in a uterus already displaced backwards. Over-distension of the bladder is not a cause but a result of this condition, as we shall see later.

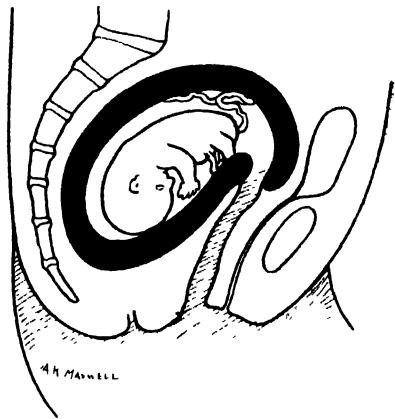


FIG. 88.—Retroflexion of Gravid Uterus.

Symptomatology.—In a large number of cases spontaneous reposition occurs; the frequency of the occurrence is impossible to estimate. The displacement is accountable for a number of abortions (p. 323) as it favours congestion of the uterus and faulty imbedding of the ovum. Sometimes it is associated with an aggravation of the early disturbances of pregnancy, such as morning sickness, depression, backache, etc.

But, generally speaking, symptoms only develop when the large gravid uterus becomes incarcerated in the true pelvis (Fig. 88). This occurs most frequently about the thirteenth or fourteenth week of pregnancy, although it may occur slightly earlier or be delayed until a week or two later. Incarceration occurs earlier with retroversion than with extreme retroflexion.

The earliest and most characteristic symptom of backward displacement of the gravid uterus is *dysuria*, which, if the displacement is not corrected, becomes more pronounced, until there is complete retention, with or without an "overflow incontinence." The disturbance in the bladder is caused by pressure on the neck of the bladder and urethra by the cervix, which is displaced upwards and forwards. This interferes mechanically with urination. The obstruction is not altogether due to mechanical pressure on the urethra by the cervix. What probably occurs is that the cervix, pressing on the veins of the bladder, produces congestion and œdema, for, as our readers will remember, the blood supply of the bladder radiates from its neck. This explains the great injury which may be inflicted on the bladder wall. We have seen portions of the mucous coat and even the entire mucous membrane separated and passed *per urethram* as a result of necrosis of the tissues. A separation of the muscular coat has also been recorded in one or two instances, but beyond a few shreds of muscular tissue this is witnessed very seldom.

Cystitis naturally results, and blood, blood-clot, pus and débris of mucous membrane may be expelled during urination or withdrawn by catheter.

In a few instances actual rupture of the bladder has occurred ; but this accident relatively seldom happens.

In consequence of these disturbances, many patients in the later stages suffer from septic absorption. Sickness, vomiting, increased pulse-rate, febrile temperature may follow, and even grave evidences of septicæmia, should the complication be allowed to continue uncorrected.

Curiously enough, pressure on the rectum, although it may aggravate constipation, very rarely indeed produces intestinal obstruction ; nor is there much complaint of general pelvic discomfort, apart from that associated with the bladder disturbances already mentioned.

Diagnosis.—On bimanual examination an elastic swelling is found in the pouch of Douglas ; the cervix may be very much drawn up and difficult to reach ; there is an absence of the enlarged uterus above the symphysis pubis. Owing to the fact that the bladder is often distended and its walls hypertrophied ("work-hypertrophy"), the error may be made of mistaking the enlarged bladder for the uterus and the swelling in Douglas' pouch for a tumour of uterus or ovary, or an ectopic pregnancy. The over-distended bladder, however, is

tender on palpation, in marked contrast to the painlessness of the gravid uterus, and it can be emptied by catheter.

The diagnosis of retrodisplacement is not always easy, although it should be suspected if there is dysuria, and especially if there is retention of urine. In a number of cases it is necessary to anaesthetise the patient before a decision can be reached. Two conditions very closely resemble it: (a) tumour (ovarian or uterine) in the pouch of Douglas complicating pregnancy; (b) the sac of an ectopic pregnancy with hæmatocele.

As regards the first, the cervix is rarely drawn up so high with tumours; and it is generally possible to define the uterus above the symphysis pubis and differentiate it from the tumour, although with a fibromyoma this may be difficult. Further, the dysuria is seldom so pronounced as with a retroverted gravid uterus, and, if the tumour is pushed out of the pelvis, this symptom disappears immediately.

Ectopic pregnancy with a pelvic hæmatocele may be very difficult to distinguish from a retrodisplaced gravid uterus, for with ectopic pregnancy and pelvic hæmatocele there is very often dysuria. The differential diagnosis of these two conditions is more fully considered later in connection with ectopic pregnancy (p. 355). It is most important that a correct diagnosis should be reached, for if attempts are made to push up an ectopic sac in the pouch of Douglas, under the impression that it is a retroflexion of the gravid uterus, the sac may be ruptured, with disastrous consequences.

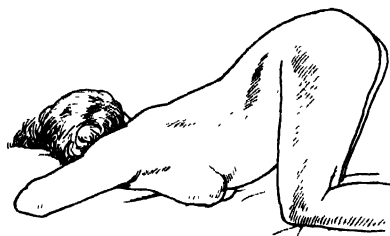


FIG. 89.—Genupectoral Position.

Treatment.—Treatment should be directed at first to the bladder, which must be emptied by a long gum-elastic catheter. Should there be any cystitis or serious injury to the bladder it should be repeatedly washed out with weak boracic solution for a couple of days before any attempt is made to replace the uterus. After the bladder is emptied the uterus can generally be pushed up by pressing upon the fundus with two fingers in the vagina. In carrying this out it may be found of advantage to place the patient in the genupectoral position (Fig. 89). Sometimes, by placing her in the Sims' position (p. 447), reposition can be effected with less discomfort. In pushing the fundus upwards, pressure should be exerted towards the side of the pelvis, and not directly upwards against the promontory of the sacrum.

If the fundus cannot be pushed up by this means the patient should be left for twenty-four hours, the bladder being kept empty, for it sometimes happens that the fundus rises spontaneously after the

manipulations, probably because they stimulate uterine contractions. If the displacement persists, the manipulations should be repeated under anæsthesia. Occasionally it happens that replacement is still unsuccessful, in which case the steady pressure by a large watch-spring pessary (p. 849) or Champetier de Ribes bag (p. 742) inserted in the vagina proves effective. Another procedure is to grasp the cervix with volsella and push the fundus upwards *per rectum*: but great traction on the cervix is contraindicated, as it is soft and easily torn.

Whenever replacement has been secured by any of the manipulations described, a well-fitting Hodge (p. 849) or watch-spring pessary should be inserted and worn until the uterus has attained such a size (eighteenth week) that a retrodisplacement cannot recur.

Very occasionally, as, for example, where the uterus is incarcerated in a flat rachitic pelvis, it has been found impossible to replace the

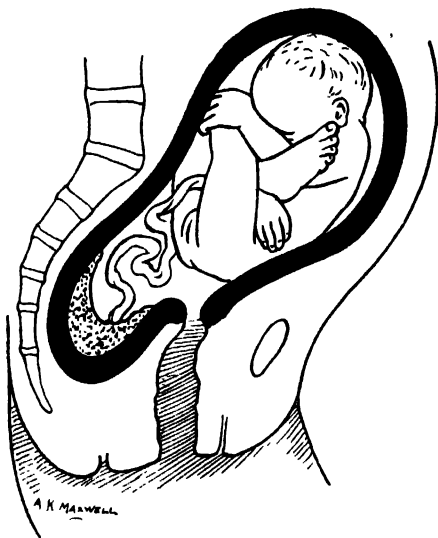


FIG. 90. --Partial Retroflexion, or Sacculation.

fundus. A number of cases of this nature have been successfully treated by abdominal section without the pregnancy being in the slightest degree disturbed. Should such treatment be necessary the fundus can be best replaced by placing the patient in the Trendelenburg position (p. 1060) during the operation, and directing an assistant to push up the fundus through the posterior fornix of the vaginal vault, the operator at the same time raising the fundus from the abdomen. A vaginal pessary is then inserted as already described and the abdomen closed.

Where repeated and energetic manipulations have been necessary it is advisable to keep the patient lightly under the influence of morphia and hyoscine ($\frac{1}{8}$ morphia and $\frac{1}{160}$ hyoscine) for a few days, so as to lessen any uterine activity which may have been induced.

Partial Retroflexion, or Sacculation.— This is a condition in which part of the uterine body remains imprisoned in the pelvis (Fig. 90). It is now generally referred to as “sacculation” of the gravid uterus. It is a relatively rare complication. It may result from adhesions anchoring the fundus in Douglas’ pouch or tumours of uterus or ovary preventing the fundus from rising. But very often neither of these causes is present, the condition being due to a partial rectification of a backward displacement.

As the portion of the uterus imprisoned in Douglas’ pouch be-

comes oedematous the condition is very confusing, and may readily be mistaken for or conversely simulated by: (a) pregnancy, with a coexisting tumour of uterus; (b) pregnancy, with a coexisting tumour of ovary; (c) ectopic pregnancy which has advanced to the later months (p. 355). By careful bimanual examination per vaginam and per rectum it is generally possible to determine the exact state of matters; but in many instances it is necessary to anæsthetise the patient before a correct diagnosis can be made.

Treatment.—Where the impaction is due to tumours, and especially where there are adhesions in the pouch of Douglas, it may be impossible to reduce the sacculation during pregnancy. In that event the pregnancy should be allowed to continue unless the symptoms, and/or discomforts experienced by the patient, compel interference and abdominal section. It is self-evident that the child cannot be delivered *per vaginam* unless the sacculatation is removed—in these very rare cases Cæsarean section is necessary.

Lateral Displacement of

Uterus.—We have already seen that the uterus towards the end of pregnancy is very often displaced to the right. This, however, is of no consequence. The lateral displacement, which we are concerned with, is that which occurs at the end of the third month, when there is great softening of the tissues between the

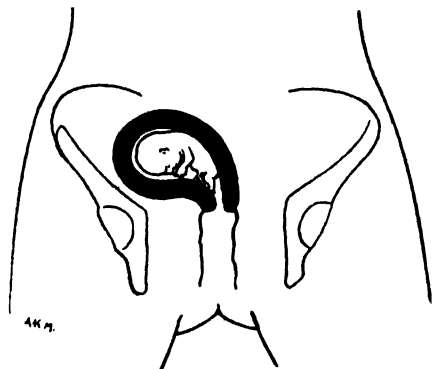


FIG. 91.—Lateral Flexion of Gravid Uterus simulating Ectopic Pregnancy.

body and cervix (Hegar's sign, p. 166). The displacement may simulate a coexisting tumour of uterus or ovary, or an ectopic pregnancy, and in a number of instances abdominal section has been performed under the impression that one of these conditions was present. Curiously enough, it is often associated with a certain degree of pain in the side—indeed in a number of cases is in reality an *angular pregnancy*, where the ovum has become imbedded in the right cornu. Angular pregnancy is referred to at the end of the chapter on Ectopic Pregnancy (p. 361). By careful bimanual examination, if need be under anæsthesia, a correct diagnosis is nearly always possible. Mistakes are made by coming to a conclusion hurriedly. This displacement calls for no special treatment.

Prolapse of Uterus.—This displacement is encountered only in the early months of pregnancy—there is no authentic case on record where a pregnancy has continued to term in a completely prolapsed uterus.

A patient with this complication complains of a feeling of weight

and bearing down. Abortion is not infrequent. In most cases the uterus rights itself as it enlarges. It never becomes incarcerated, although the cervix may become markedly œdematous and may even project well beyond the vulvar orifice. When this occurs it may become gravely infected. The condition, therefore, requires very careful attention prior to the onset of labour as infection may readily extend upwards to uterine cavity post partum.

Replacement is usually easy, and after this has been brought about a watch-spring pessary should be inserted to maintain the uterus in position. This instrument should be removed from time to time and cleansed, and may be dispensed with after the eighteenth week.

OTHER COMPLICATIONS

Acute Œdema of the Cervix.—Associated with the condition of prolapse there may arise quite suddenly an acute œdema of the cervix. This complication is immediately followed by severe pain. We have seen the cervix become enormously enlarged and very sensitive to touch. With rest in bed and hot vaginal douches the œdema soon disappears. It is most common in the later weeks of pregnancy.

Hypertrophy of Cervix.—The subject of hypertrophy of the cervix is considered in the gynæcological section (p. 906). Here we are only concerned with the condition as it complicates pregnancy. In pregnancy it seldom gives rise to much disturbance, although the leucorrhœal discharge from the cervix may produce a certain amount of irritation. Generally speaking, the discomforts associated with it disappear in the later months unless an acute œdema occurs.

In some few instances where there is very pronounced hypertrophy the œdematous cervix projecting beyond the vulvar orifice becomes extremely swollen, ulcerated and heavily infected. The danger in such cases is post-partum uterine infection.

Treatment consists in hot vaginal douches, disinfection of cervix and rest in bed. We believe it inadvisable, as has been recommended by some, to amputate the cervix. In the first place, this is unnecessary, as parturition later is rarely seriously disturbed (p. 541); and secondly, amputation may lead to cicatrices which retard dilatation during labour.

Malformations of Uterus.—The development of the reproductive organs and the different malformations which may result have been described (pp. 89 to 103). Here we are only concerned with malformations as they affect pregnancy.

Extreme malformations, such as uterus didelphys (p. 101), in which there are two distinct uteri and vaginæ, seldom give rise to any trouble during pregnancy. There are even some cases on record where each half has become gravid and pregnancy has progressed undisturbed. Occasionally it has happened that the non-gravid half has become displaced into the pouch of Douglas and has interfered with the growth

of the gravid half, or with the passage of the child during delivery. Again, there have been cases in which tumours of the non-gravid half (fibromyomata) have caused serious complications; but we cannot discuss such rarities here.

The less pronounced malformations, where there is a communication between the two halves, such as the uterus subseptus and bicornis (p. 102), are frequently associated with abortion or premature labour. Should pregnancy continue, malpresentations are not infrequent.

In the slightest deformity of all, the uterus cordiformis (p. 103), pregnancy progresses undisturbed, but an oblique or transverse "lie" of the child is frequently observed (p. 476).

Diagnosis.—The diagnosis of malformation of the uterus complicating pregnancy is not always easy. There is, of course, no difficulty in coming to a conclusion if two vaginal orifices are visible, but where the duplication of the vagina and/or uterus is not obvious the condition is more obscure. Duplication of the uterus may closely resemble a tumour of uterus or ovary complicating a normal gravid uterus. In many cases, therefore, it is necessary to make a careful examination under an anæsthetic, not only by the vagina but also by the rectum, before a decision can be reached.

Treatment.—No treatment is called for during pregnancy. Difficulties arising in connection with parturition are referred to elsewhere (p. 548). Plastic operations for malformations of the uterus are considered in Chapter LVII.

One particular malformation, by no means uncommon, calls for comment—namely, pregnancy in a "rudimentary horn" of a double uterus. This condition is fully considered under Ectopic Pregnancy (p. 359), which it very closely resembles.

Hernia of Uterus.—Hernia of the uterus into the inguinal canal has been occasionally observed, and there are instances in which a pregnancy has actually developed in a uterus so displaced. If this extremely rare complication should be encountered, surgical treatment is called for. The uterus should be replaced in the abdominal cavity and the canal closed.

A more common complication in ordinary domestic practice is extreme antelexion in the later months associated with pendulous abdomen, a condition which has been referred to already (p. 287).

A hernia of the gravid uterus between the recti muscles or through a weak abdominal cicatrix is occasionally encountered. Cases have even been described where the ring of the hernial sac has been so tight that there has been difficulty in getting the uterus replaced. Generally, however, it can be replaced and held in satisfactory position by an abdominal binder. Such hernias should not be repaired during pregnancy: the operation should be performed soon after parturition, when the abdominal walls are lax and the edges of the ring can be more easily and exactly brought together.

TUMOURS COMPLICATING PREGNANCY

Tumours are not infrequent complications of pregnancy. The three commonest are : (1) fibromyoma of the uterus ; (2) carcinoma of the cervix ; and (3) ovarian cystoma. But besides these, others may be encountered, such as : (4) solid and cystic tumours of vagina ; (5) solid and cystic tumours of vulva ; (6) tumours of rectum ; (7) tumours of bladder ; and (8) tumours of bony pelvis and cellular tissue.

(1) **Fibromyoma of Uterus.**—We do not propose to consider fibromyomatous tumours at this point. The ætiology, symptomatology, diagnosis and treatment of this very common neoplasm are fully discussed in the gynæcological section of this work (p. 931).

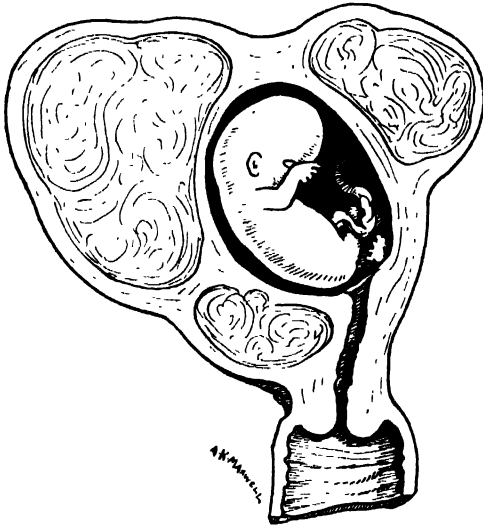


FIG. 92.—Fibromyomata of Gravid Uterus.

When palpating a gravid uterus, fibromyomata are often felt. It is estimated that they are present in somewhere from 5 to 7 per cent. of pregnant women. Generally they are small growths of no serious consequence. If of larger size (Fig. 92) they predispose to abortion. Furthermore, they are a relative barrier to conception.

Tumours which disturb pregnancy are generally located in the lower part of the uterus and project into the true pelvis. As the uterus enlarges, these growths increase in size partly from hypertrophy of the muscle fibres but chiefly from œdema. Thus they may exercise pressure on the surrounding parts and cause more or less discomfort or pain. Such symptoms are grouped under the term "pressure symptoms"—dysuria, obstinate constipation, with occasional rectal tenesmus, pelvic neuralgia and venous-engorgement. The extent to which the tumours enlarge is very variable. Those of the interstitial variety (p. 934) are specially prone to undergo enlargement.

Apart altogether from the disturbances mentioned, these tumours not infrequently undergo different forms of degeneration (p. 940), more particularly "red degeneration." When this degeneration occurs, the tumour becomes enlarged and sensitive to pressure. The patient often complains of great pain, and there is occasionally a very slight rise in pulse and temperature and sickness. The appearance of such a tumour, if removed, is characteristic—its cut surface resembles a raw beefsteak, hence the term "red degeneration" (Necrobiosis, p. 942).

Treatment.—Fibromyomata complicating pregnancy, provided they are associated with no symptoms, should be left alone, even although one knows that ultimately the child may require to be delivered by Cæsarean section (*vide* p. 718).

Pressure and other symptoms can generally be relieved by rest in bed, a slightly restricted diet, regulation of bowels and increase of urinary output. Therefore this treatment should be tried before having recourse to operation. Sometimes, too, by pushing up the tumour in the pelvis and inserting a pessary, discomforts can be removed and pregnancy allowed to continue. *We would emphasise the importance of employing palliative measures, as in many instances this is the woman's only chance of having a child.* Should, however, the symptoms become especially severe, and palliative treatment fail, operation becomes necessary. Then the surgeon must decide between myomectomy (enucleation of the tumour) and hysterectomy (removal of uterus and tumour) (Chapter LVII. He will be guided to a decision by the nature and the extent of the tumours, the symptoms present, the number of children the patient may have had and the wishes of the patient. We would only remark that in the primigravida, myomectomy (enucleation of tumour) is the operation of choice. The incidence of abortion following myomectomy is approximately 20 per cent. Abortion is less likely to occur if myomectomy is performed in the earlier months when hormonal control of uterine activity is at its height. Progesterone may be given with this object (p. 334).

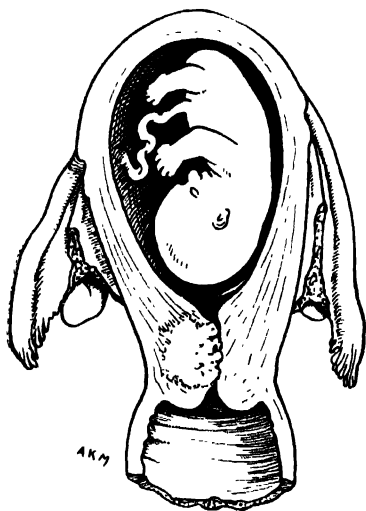


FIG. 93.—Early Intracervical Carcinoma.

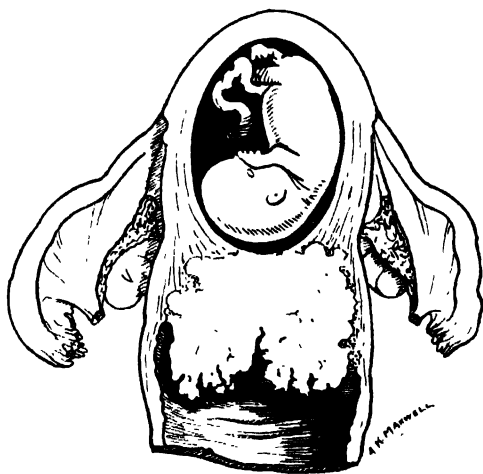


FIG. 94.—Advanced Carcinoma.

(2) **Carcinoma of Cervix.**—Carcinoma of the uterus is considered in the gynæcological section (p. 959). For the moment we are concerned with the tumour as a complication of pregnancy (Fig. 93). This condition is associated with irregular vaginal hæmorrhage, but

in addition there may be a watery discharge or increase of the ordinary mucous discharge from the vagina. The patient very seldom complains of pain; she generally seeks advice because of hæmorrhage. On making a vaginal examination the cervix bleeds readily when touched and feels irregular and harder than normal. If the disease is advanced, portions of tissue may be detached from the cervix by the examining finger. Inspected through the speculum it presents appearances described later in the gynæcological section. The tumour to some slight extent may favour the occurrence of abortion; but not to a pronounced degree, as in most cases pregnancy goes on to term, even when the disease is far advanced.

Treatment.—The treatment depends upon whether the condition is “operable” or “inoperable” (when only palliative measures are possible). A decision regarding operability is arrived at by determining the extent to which the disease has advanced. Conditions unfavourable to operation are extensive spread of the carcinoma to the vagina, involvement of the paracervical tissue, fixation of the uterus and any involvement of bladder and rectum. These matters, however, are more fully considered in the gynæcological section (p. 974). We would only remark here that, as regards involvement of the paracervical tissue, this is best determined by a rectal examination.

If the particular case is deemed “operable,” then the radical or Wertheim operation (Chapter LVII) should be performed immediately, or the ovum should be removed and the carcinoma treated by radium (p. 972). There should be no delay, as every week lost lessens the chances of permanent cure. When, however, the condition is considered “inoperable,” then pregnancy may be allowed to continue, the object being to save the child. In such cases the child should be delivered by Cæsarean section and *subtotal* hysterectomy (p. 725) performed. The object of this procedure is to save the patient from the severe hæmorrhage incidental to parturition and infection after delivery. These dangers are referred to in connection with carcinoma of the cervix complicating labour (p. 541).

The excellent results from treatment by radium, even in cases moderately far advanced, have considerably altered the attitude towards permitting pregnancy to continue even in very unpromising cases. More and more in such cases is there a tendency to empty the uterus by abdominal hysterotomy (p. 740), or remove the uterus by subtotal hysterectomy in order to institute treatment by radium as early as possible.

The employment of radium while leaving the foetus undisturbed *in utero* is not viewed with favour, as there is always the possibility that, if the modern methods of radium application are used, the foetus may be injuriously affected. The only safe application would be for the container of the radium to be in the form of a plaque which could

be directly applied to the ulcerated cervix ; but this is not as effective a method of application (*vide* Radium Application, p. 972).

(3) **Ovarian and Parovarian Tumours.**—These tumours may be discovered quite accidentally in pregnant and parturient women. Generally speaking, they disturb the pregnancy very little unless some complication occurs, as, for example : (a) torsion of the pedicle (symptoms—sudden abdominal pain, sickness and collapse) (p. 1022). This happens in about 15 per cent. of cases. (b) Rupture of the cyst. This is usually associated with abdominal uneasiness, and there may be a slight rise in temperature and a moderate degree of abdominal tenderness (p. 1024). (c) Injury and necrosis of tumour from pressure. This particular occurrence is relatively infrequent in pregnancy. It generally follows pressure on the tumour during labour. (d) Displacement of the uterus.

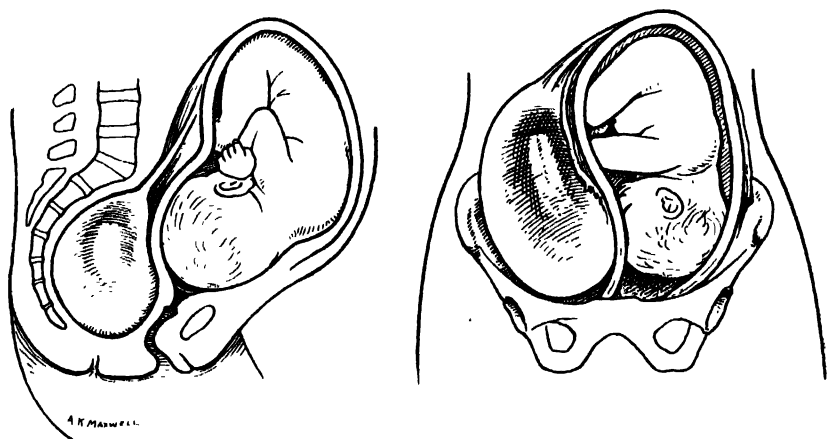


FIG. 95.—Ovarian Cyst complicating Labour. In left-hand figure the tumour is situated in the pelvis ; in right-hand figure the tumour is above pelvic brim.

Unless the tumour interferes with the growth of the uterus, pregnancy usually continues undisturbed. Details regarding ovarian tumours and the complications which may arise in connection with them are considered in the gynæcological section of this work (p. 995) ; while the disturbances they produce during labour and the mechanical obstruction they may cause are described in Chapter XXXI (p. 550) and in Chapter L (p. 1005).

Diagnosis.—The diagnosis of these tumours is simple if they are of considerable dimensions and displace the uterus, or are situated in the pelvis, for then they can be readily palpated as distinct swellings apart from the uterus. If, however, they are small and above the pelvic brim, they are not easily defined, especially in advanced pregnancy (Fig. 95).

Treatment.—It is generally accepted that whenever an ovarian

tumour is recognised abdominal section should be performed. The objection to such a procedure is that abortion may be induced; but this seldom occurs if every care is taken to remove the tumour as gently as possible. After ovariectomy has been performed the patient should be kept under the influence of progesterone (p. 334) in order to lessen the risks of uterine activity and abortion. It would appear from statistics that the tendency to abortion is slightly greater in the later months, because hormonal control of uterine activity is less than in the earlier months. It may be advisable, therefore, if the pregnancy has reached the thirtieth week or thereabouts, to delay operation for a week or two until the child is viable, in case premature labour should result.

(4) **Solid and Cystic Tumours of the Vagina.**—Such growths are relatively uncommon, but fibromyomata of the anterior and posterior walls and cystic tumours more laterally situated are encountered occasionally. These tumours are fully considered in Chapter XLVI (p. 898). They are very easily recognised by vaginal examination as smooth growths projecting into the lumen of the vagina. They rarely cause any disturbance of pregnancy, but occasionally they interfere with the descent of the foetus (p. 540). They should, in all cases, be removed; this is generally a simple procedure, and consists in enucleating the tumour. In those situated in the anterior wall special care must be exercised, as urethra or bladder may be very easily injured. The only question is whether the removal should be delayed until parturition, or performed during pregnancy. We think, on the whole, it is better to remove them whenever they are recognised, for if removed during parturition the wound in the vagina may be extended during descent of the child, and furthermore it may become infected.

(5) **Solid and Cystic Tumours of the Vulva.**—The tumours of the vulva occasionally encountered in pregnant women are those described in Chapter XLVI (p. 890). Speaking generally, they cause very little disturbance to pregnancy, but occasionally they may interfere with the delivery—they should be removed when recognised.

One of the most troublesome vulvar conditions is abscess of Bartholin's gland (p. 884), which, as shown in the illustration (Fig. 7), is placed laterally and somewhat posteriorly to the vulvar opening. An extension of infection upwards to vagina and uterus is specially liable to occur during parturition and so the whole gland should be removed; it is not sufficient to incise it simply.

(6) **Tumours of the Rectum.**—This is a very rare complication. The tumour is generally a carcinoma of the rectum, which may assume considerable dimensions before it is recognised. If the condition is "operable," a radical operation should be performed, or radium should be employed; if it is "inoperable," pregnancy may be allowed to continue. There are a few cases now on record in which pregnancy has continued undisturbed after the radical operation.

(7) **Tumours of the Bladder.**—Tumours and calculi in the bladder are extreme rarities. They or other lesions of the bladder, when encountered during pregnancy, should be dealt with by the ordinary recognised procedures.

(8) **Tumours of Bony Pelvis and Cellular Tissue.**—Such tumours seldom disturb pregnancy, but they may interfere with parturition. They are therefore referred to in connection with tumours complicating labour (p. 518).

CHAPTER XV

DISEASES AND ABNORMALITIES OF THE OVUM

Hydatidiform Mole—Other Diseases of Chorion · Diseases of Amnion—
Diseases of Placenta

THE ovum may show signs of disease in any of its component parts—chorion, amnion, placenta or foetus. The lesion may be confined to one part, or involve all the tissues of the ovum.

DISEASES OF THE CHORION

Hydatidiform Mole.—This condition has been variously described as vesicular mole, cystic degeneration of the chorion, and myxoma of the chorion. Along the course of the chorionic villi transparent vesicles develop, varying in size from a pinhead to a hazel nut; they hang like bunches of white currants (Fig. 96). This alteration may involve all the villi or only a portion of them. The vesicles were at different times described as hydatid cysts or multiple ova, but the condition is now recognised to be a disease of the chorion.

INCIDENCE.—It is a comparatively rare complication, its frequency having been variously estimated as from 1 in 2000 to 1 in 20,000 cases of pregnancy. It is most frequent in women between the ages of twenty-five and thirty-five. The degeneration usually commences at the stage when the entire chorion is villous, viz., prior to placental formation, hence no trace of the embryo may be found; when it occurs later the placenta, and usually only a restricted area of it, shows the characteristic degenerative changes. In twin pregnancy, one ovum only may be affected. The condition may occur in a tubal gestation, and has even been found in an ovarian pregnancy.

PATHOLOGY.—The decidua merely shows hypertrophy with round-cell infiltration. The essential lesion is in the epithelial covering of the chorionic villi—the syncytial and Langhans' layers. These layers undergo extensive proliferation and penetrate deeply into the decidua, even into the muscular coat. Cases are described in which the whole thickness of uterine wall has been traversed and peritoneal cavity entered. The blood-vessels of the terminal portions of the villi disappear and the stroma degenerates, the nuclei losing their staining reactions. The centre of the bulbous portion of the villus undergoes necrosis, and the cavity thus produced contains fluid (0·6 per cent. albumin and 0·3 per cent. mucin). Necrotic stroma cells line the cavity. Localised areas of each villus show this degenerative change, with the result that the unchanged portions form the fine stalks connecting the

cysts to one another. The lesion seems to be a primary cedematous change, with secondary necrosis of the connective tissue.

The burrowing processes described above are very similar to those which occur in *Chorionepithelioma*, and we shall have occasion to refer to the fact that 10 per cent. of the cases of hydatidiform mole are followed by a chorionepithelioma. An attempt has been made to distinguish, on a histological basis, cases which are likely to

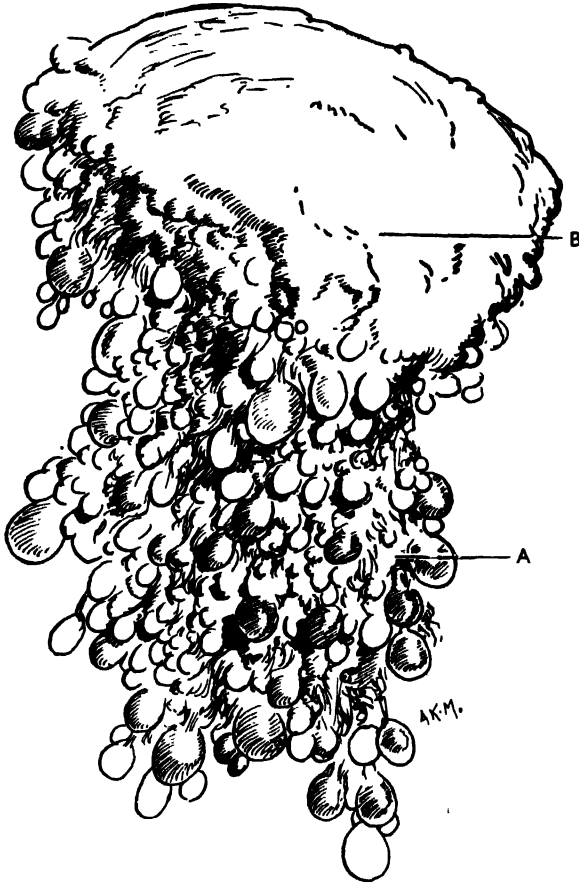


FIG. 96.—Portion of a Hydatidiform Mole.

A, Cystic chorionic villi. B, Blood clot.

develop into chorionepithelioma and those which are not. Some pathologists find their evidence in the fact that, in what seem to be the more malignant cases, the proliferating epithelium invades the stroma of the villi, while in the others it remains confined to the periphery. Then again, special importance has been attached to some very large cells which develop in Langhans' layer and become "wandering cells," undergoing at the same time active mitotic changes. These cells seem to be specially noticeable in the more malignant type.

Recently the degree (gauged by dilution of the urine) of the reaction in the Aschheim-Zondek or Friedman tests, which are very pronouncedly positive in this condition, has been invoked. However, there is not yet sufficient evidence to show that the malignancy of a hydatidiform mole can be decided by histological or biochemical examination of the expelled mole, or by any other means. *All hydatidiform moles have malignant potentialities.*¹

Changes in the Ovaries.—The ovaries show cystic degeneration in about 50 per cent. Multiple lutein cysts occur, as large as 5 or 6 cm.



With permission from Eden and Holland's "Manual of Midwifery."

FIG. 97.—Vesicular Mole. Section through a Chorionic Villus.

in diameter. The whole organ may present the appearance, on section, of a cystic kidney (p. 987). An aetiological relationship has been claimed for these two conditions. That this is so may be argued from the fact that the lutein cysts usually disappear after expulsion of the mole.

CAUSATION.—The cause of the hydatidiform mole lies in the ovum itself: the endometrium (decidua) plays no part. This is confirmed by the uniovular affection which may occur in twin pregnancy, and by the localised areas affecting the placenta in some instances.

The changes in the ovary are secondary and are due to excess of

¹ Novak suggests that the condition should be looked upon as a new growth.

luteinising hormone from the anterior lobe of the pituitary gland. This again is probably secondary and the result of an inherent or primary pathological condition of the zygote ; although it has not been absolutely proved that hydatidiform mole may not be caused by a primary pathological activity of the said hormone. The distension of the uterus is due not only to the great bulk of the mole but also to blood-clot lying between the mole and the uterine wall.

CLINICAL HISTORY.—The change in the ovum usually occurs within the first two months of pregnancy. In cases involving the whole chorion, the embryo disintegrates and the only trace of it may be a small stump—the maternal end of the umbilical cord. The mole continues to grow after the death of the embryo—the proliferating epithelium is nourished by the maternal blood in the decidual sinuses.

The uterus may enlarge very rapidly. In some 60 to 70 per cent. of cases the most striking manifestation of the condition is a uterus enlarged beyond the size normally associated with the period of amenorrhœa—at three months it may have reached the size of a seven months' pregnancy. On the other hand, there occur a number of cases in which the uterus is not unduly enlarged for the period of amenorrhœa.

The uterus, enlarged in most cases as stated, is generally insensitive to pressure ; but occasionally the intrauterine tension causes a feeling of abdominal uneasiness. Although it is often stated that the consistency of the enlarged uterus is "doughy," we have found that this is by no means a constant feature ; in most instances the uterus is firm or elastic to pressure.

Penetration of the villi through the uterine wall with severe and even fatal intraperitoneal hæmorrhage is fortunately an extremely rare occurrence. Rare also are metastases to lungs and elsewhere while the mole is retained. Generally such occurrences follow some time after its expulsion, and are due to the development of a chorion-epithelioma (p. 984).

A hæmorrhagic watery discharge may occur, and occasionally the characteristic vesicles may be found in the discharge as little yellow currant-like bodies. The discharge consists sometimes of a free hæmorrhage ; but profuse hæmorrhage is not common.

General disturbances may be marked, owing to the absorption of the products of necrosed tissue. The temperature may be elevated, the pulse-rate increased, and all the evidences of cachexia be present. Where the growth of the mole is very active there may be albuminuria, œdema and vomiting. Cases of very persistent *hyperemesis gravidarum* are sometimes found to be due to hydatidiform mole formation. Eclampsia has developed in some instances.

DIAGNOSIS.—The characteristic features are the size of the uterus out of proportion to the duration of pregnancy, the absence of the foetal heart-sounds, the impossibility of palpating foetal parts, the absence of ballottement, and the characteristic vaginal discharge. The diagnosis

from hydramnios may present difficulties—here an X-ray film will be helpful in making a differential diagnosis. Sometimes the condition may simulate placenta prævia if there is free hæmorrhage and the fore-finger passed through the dilated cervix feels the mole. Very occasionally if the uterus is moderately enlarged and firm a differential diagnosis from a fibroid tumour may have to be considered.

Of inestimable value in the diagnosis of this condition is the Aschheim-Zondek or Friedman test. The reaction is markedly positive even with considerable dilution of the patient's urine (p. 168).

PROGNOSIS.—The prognosis is fairly grave. Immediate death may occur from hæmorrhage (3 per cent. of cases), from sepsis (5 per cent. of cases), and from injury (rupture) to the uterus in removing the mole. Death at a later period may occur from chorionepithelioma, which appears as a sequel in 10 per cent. of cases. *This grave sequel is definitely more frequent in women above forty years.*

The condition may recur in successive pregnancies, but this is very exceptional. The mole is usually expelled spontaneously in the absence of serious complications where the uterus has enlarged to the size of a sixth months' pregnancy.

TREATMENT.—Once a diagnosis of hydatidiform mole has been made, the uterus should be emptied. An attempt should first be made to get the uterus to expel the mole itself, by "medical induction" of labour (p. 734)—hot vaginal douches may aid expulsion.

If the mole is not expelled by these means the cervix should be dilated with tents (p. 738), still in the hope that spontaneous expulsion will occur, as manual removal is usually associated with considerable hæmorrhage and the danger of perforating the uterus. Before beginning any intrauterine interference, one must be prepared to deal with severe hæmorrhage by blood transfusion and other measures.

Manual removal is carried out as follows: Subsequent to a thorough cleansing and disinfection of the vulva and vagina, the lower vagina is stretched by "ironing" it out (p. 693). One hand is then introduced into the vagina and two fingers are passed through the dilated cervix, while the other hand steadies and presses down the fundus externally. The mole is then removed piece by piece until the uterus is completely evacuated. In practice it is very seldom possible to get one's fingers into the uterus unless the whole hand is passed into the vagina. Fortunately hydatidiform mole generally occurs in multiparæ. *No form of curette should be used* because the uterine wall may be so much thinned out. When the cavity has been cleared, a hot intrauterine douche should be given. Ergot should be administered in the puerperium to stimulate contractions, as the muscle-tone of the uterus is impaired.

More surgical measures have been advocated in recent years for this condition. The fear of malignant sequelæ has encouraged *supravaginal hysterectomy* with the mole *in situ* as appropriate treatment

in women of forty years or over—with such an attitude we are in agreement. There are clinicians who recommend hysterectomy in all cases, but the number of malignant recurrences does not justify such treatment in younger women. A less radical procedure is to evacuate the uterine contents by *abdominal hysterotomy* (p. 738)—this method has the advantage of allowing the uterus to be cleared under direct vision, and of securing a more complete removal of the mole. The objection to the method is weakening of the uterine wall and rupture should a pregnancy occur subsequently. *Vaginal hysterotomy* (p. 738) gets over that objection and we recommend it in cases in which there is great difficulty in dilating the cervix and provided the uterus is not too large and can be pulled down readily.

All cases of hydatidiform mole in which the uterus has not been removed must be kept under observation for two years. Even when the immediate convalescence is quite satisfactory the patient should be brought back for re-examination at regular intervals, so that any menstrual irregularity may be at once identified and its cause investigated. If red discharge persists at the end of three or four weeks it is generally recommended that the uterus should be curetted and the tissue examined for persisting chorionic epithelium with malignant proliferation. There is, however, grave danger of perforating the uterine wall even if a blunt curette is employed. Besides, the curette may miss an early tumour. We recommend, therefore, basing treatment on the Aschheim-Zondek or Friedman test and dispensing with curettage. The test normally becomes negative a few days after delivery; but should the reaction remain or become positive one can be certain (provided another pregnancy can be ruled out) that chorion-epithelioma has developed, in which event the uterus and appendages should be removed.

Chorionepithelioma.—Chorionepithelioma is dealt with along with tumours of the uterus in Chapter XLIX (p. 984).

Diffuse Myxoma of the Chorion.—In this very rare condition the connective tissue of the chorion undergoes myxomatous degeneration, causing the formation of a layer of tissue similar to Wharton's jelly. The progress of pregnancy is not affected.

Myxoma Fibrosum of the Chorion.—This condition, in which groups of chorionic villi coalesce to form a dense connective tissue tumour, with areas of myxomatous degeneration, will be dealt with under Tumours of the Placenta (p. 313).

DISEASES OF THE AMNION

Hydramnios.—In this condition the amount of liquor amnii is excessive. Whereas the normal amount is 1 to 3 pints (1 to 2 litres), in hydramnios there may be 10 to 25 litres. The fluid is identical in composition with the normal liquor amnii, except that there may

be a little more urea present. It is generally a complication of the second half of pregnancy, is more common in multigravidæ than in primigravidæ, and in uniovular plural pregnancy.

PATHOLOGY.—The normal source of the liquor amnii has already been considered (p. 136). The reason for the excessive fluid in hydramnios is not quite clear. There is no evidence that the condition is of syphilitic origin, although it may be associated with syphilitic lesions in mother or child.

(a) *Fœtal Origin.*—That the excessive fluid is due to the fœtus might be argued from the frequent association of this condition with plural pregnancy (uniovular) and with deformities of the fœtus, such as spina bifida, anencephaly, hare-lip, club-foot, ectopia vesicæ and fœtal dropsy.

There may be circulatory disturbances in the cords, placenta, or within the fœtus. Where there is an obstruction in the umbilical vein, due to stenosis or thrombosis of the vein, or excessive torsion of the cord, there will be an exudate of fluid from the surface of the cord. Some specimens have been examined from hydramnios cases, in which there have been found persisting “the *vasa propria* of Jüngbluth, which spring from the fœtal end of the cord between chorion and amnion and are usually obliterated by the second half of pregnancy” (Stander). The persistence of these structures would indicate some special activity in the tissues of the cord (*vide* also Chorio-angioma, p. 313).

Within the fœtus, cirrhosis of the liver, which need not be syphilitic in origin, or cardiac abnormalities such as stenosis of the pulmonary arteries, may interfere with the circulation through the umbilical vein.

It has been observed that hydramnios is *specially liable to occur in uniovular twins*, and particularly in the amniotic cavity of one of the twins. Here there is a common placenta with the two fœtal circulations communicating. The uniovular twins are the less frequent type of twins (p. 493), but are the type most commonly associated with hydramnios. The fœtus in the enlarged sac is found to be of larger size and to have the heart and kidneys definitely hypertrophied. This is adduced as evidence of the excessive secretion of fœtal urine, but cases have also been observed in which hydramnios has been associated with atresia of the fœtal urethra.

Cases have been described in which hydramnios has been associated with lesions in the fœtal skin such as nævi, or where the skin is much thickened; but these same lesions are found without hydramnios.

(b) *Maternal Origin.*—Hydramnios may occur in association with cardiac or renal disease in the mother. This is especially likely where there is an interference with the circulation, and also in visceral syphilitic lesions. These conditions may cause œdema of the placenta and excessive transudation into the amniotic cavity. Hydramnios is a relatively frequent occurrence in diabetics.

Acute hydramnios may follow an injury to the mother.

Occasionally the condition is found in abortions—the “dropsical ovum”—where the foetus may have entirely disappeared or be represented by a nodule of tissue. It has also been found in cases of ectopic gestation.

In conclusion, while there is no definite evidence to indicate the actual source of excessive amniotic fluid, the fact that in 50 per cent. of the cases of hydramnios there is an abnormality of the foetus is very suggestive that the cause is often foetal. The large epithelial cells of the amnion (p. 137) show under the microscope the evidence of increased activity.

CLINICAL HISTORY.—The condition may develop very slowly—(a) chronic hydramnios—or its onset may be very sudden—(b) acute hydramnios.

(a) *Chronic Hydramnios*.—This is much the more common variety. The increased size of the uterus becomes apparent in the later weeks of pregnancy. There may be little subjective disturbance until the uterus becomes very large, when the increased pressure on the viscera may cause flatulence and dyspepsia. Pressure on the diaphragm may eventually cause palpitation, dyspnoea and sometimes cyanosis. Varices and oedema of the legs may develop. An enormous amount of fluid may accumulate in the uterus without any great discomfort to the patient, provided the increase is gradual. The pressure in such cases is entirely due to the bulk of the uterus.

(b) *Acute Hydramnios*.—This type is less common. It may manifest itself early (eighteenth to twentieth week), or may occur as a sudden development in the chronic form. The sudden onset does not allow the uterus and the abdomen to accommodate themselves to the increased amount of fluid, consequently it may be associated with severe pain and vomiting. The pulse-rate rises, the patient suffers from extreme dyspnoea, and the temperature may rise. Oedema of the abdominal wall may occur. This acute form is peculiarly associated with the presence of uniovular twins.

DIAGNOSIS.—Hydramnios may be suspected if the maximum circumference of the body at the level of the umbilicus is over 38.40 inches in the latter half of pregnancy. The uterus is enlarged beyond the period of pregnancy and the uterine wall is very tense and often tender to palpation. The abdominal wall is thinned out and the recti muscles separated. Ballotement can be obtained easily, but there may be too much fluid to allow the foetus to be palpated. The overstretching of the uterine wall causes loss of tone, and therefore the alternate contractions and relaxations may be absent. Fluctuation is easily elicited. The foetal heart may be heard with great difficulty; and malpresentations are common.

There may be confusion regarding a normal pregnancy when the menstrual dates are inaccurately reported. Multiple pregnancy may cause some difficulty in diagnosis. As already remarked, hydramnios

and multiple pregnancy coexist in many cases. The diagnosis is established by radiography—a radiograph should be taken in all cases of hydramnios. In hydatidiform mole there is no ballottement or foetal heart-sounds to be heard and there is a pronouncedly positive Aschheim-Zondek reaction. Ovarian cysts do not give ballottement or a foetal heart, and the uterus can usually be defined; but if an ovarian tumour and pregnancy coexist the diagnosis may be much more difficult, although the outline of the two tumours can generally be identified. It may on occasion be necessary to make a diagnosis from concealed accidental hæmorrhage; but in this condition the patient is collapsed, and the uterine wall is board-like and tender to palpation (p. 586).

PROGNOSIS.—Premature labour occurs in the majority of cases, and in 50 per cent. the foetus is deformed. The excessive fluid causes malpresentations, but as the foetus is usually premature, the extraction is not specially difficult. The overstretching of the uterine wall causes primary uterine inertia; and, for the same reason, the uterus may not retract well after labour and postpartum hæmorrhage may occur. The membranes may rupture very early—prolapse of the cord sometimes occurs in the rush of escaping fluid. Further, it has been estimated that less than 10 per cent. survive as healthy children at the end of a year in cases of marked hydramnios. The prognosis for the child, therefore, is not good.

TREATMENT.—There is no prophylactic treatment against this condition. It is now customary to have a radiograph taken in all cases of hydramnios, (a) to determine if plural pregnancy exists, and (b) to determine if foetal abnormalities exist. If the child or children are healthy nothing should be done unless the condition is causing great respiratory distress or is having a prejudicial effect. Should, however, these disturbances develop, some recommend tapping the amniotic sac through the abdomen and withdrawing some fluid; if only a moderate amount of fluid is withdrawn labour may not be induced. The operation may be repeated. If, on the other hand, the radiograph shows that the foetus is malformed, the membranes should be perforated through the cervix and the liquor amnii allowed to drain away. This procedure is made easy by the fact that the cervix is very often patent as a result of the overstretching of the uterus; it always brings on labour. The patient must be carefully watched during the third stage in case postpartum hæmorrhage occurs.

Oligohydramnios.—The amniotic fluid may be very scanty; there are no maternal symptoms. The ætiology is unknown. Forssell has suggested necrosis of the amniotic epithelium as the most likely cause. Cases have been described where the condition was associated with congenital absence of the foetal kidneys or an imperforate urethra. But these conditions are probably only coincidences, as we know how little the quantity of the amniotic fluid is dependent upon the foetal urine (p. 13). When oligohydramnios occurs early, the foetus is

usually much deformed owing to the formation of adhesions between the foetus and the amnion. When it occurs late the foetus is pressed on all sides, and minor deformities such as club-foot may result. The skin of the foetus may be very dry and leathery. Cases have been recorded in which descent of child was retarded owing to the adhesions.

Amniotic Adhesions.—Adhesions between the foetus and the amnion occur not only in oligohydramnios but also occasionally when the amniotic fluid is normal in amount. These adhesions usually form early and all degrees of deformity may result—*e.g.* encephalocele, exomphalos, fissures of the face, jaw or thorax, and amputation of the extremities. The adhesions may give rise to dystocia. Stander¹ in the latest edition of William's textbook stresses the view of Streeter that the majority of these deformities are due to deficient or abnormal development which is probably correct, although some are undoubtedly due to amniotic bands.

Minor Affections of the Amnion.—Small cysts and caruncles of the amnion may be found—they have no clinical significance.

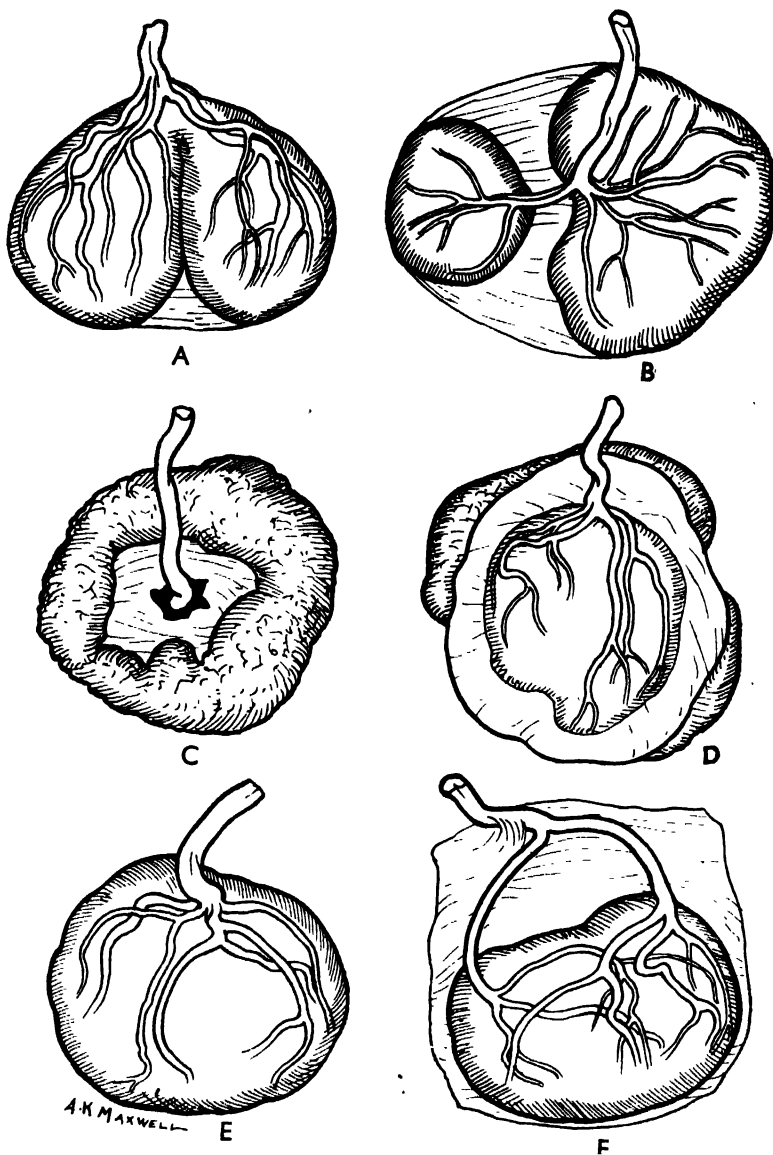
DISEASES OF THE PLACENTA

Abnormalities in Shape, Development and Position.—Great variation in the shape of the placenta may take place as a consequence of disturbances, local or general, in the relations of the chorionic villi and the decidua during the early weeks of development. The normal placenta has been described (p. 81).

Where the bulk of the chorion laeve (p. 81) takes part in the formation of the placenta, a *placenta membranacea* results, lining the greater part of the uterine cavity (Figs. 98 and 99, C). This type does not separate easily in labour, and may require manual removal. A division of the placenta is found in *placenta bipartita* or *tripartita* (Figs. 98 and 99, A)—in these forms the separation is not complete and the vessels pass from one lobe to the other before forming the cord. In *placenta duplex*, *triplex* or *multiplex* the separation is complete, and the cord breaks up into branches which pass to each separate lobe. *Placenta succenturiata* (Figs. 98 and 99, B) is a variety of *placenta duplex* or *multiplex* where one lobe is much larger than the others and the blood-vessels pass from the accessory to the main lobe along the membranes. Occasionally the vascular connection of the small lobe atrophies and we have *placenta spuria*. *Placenta succenturiata* has considerable clinical significance. The small lobe or lobes may be left behind in the uterus. If the membranes are carefully examined there will be found a large rent with blood-vessels leading across the membranes to it. If this condition is not detected and the lobe removed, post-partum hæmorrhage, severe after-pains, saprophytic infection, sub-

¹ "William's Obstetrics," 8th Edition, 1941, p. 745.

involution, or the formation of a placental polypus may be the sequelæ.



FIGS. 98 and 99.—Variations in Form of Placenta.

A. Placenta Bipartita.

C. Placenta Membranacea (folded over).

E. Battledore Placenta.

B. Placenta Succenturiata.

D. Placenta Circumvallata.

F. Placenta Velamentosa.

In *placenta fenestrata* there is a defective area in the middle of the organ which appears like a window. This condition is due to the maldevelopment of the central groups of villi. In *placenta circum-*

vallata there is a central depression on the foetal surface at the edges of which the membranes are attached (Figs. 98 and 99, D). There is a ring of thicker placental tissue round the margin due to a proliferation of villi and decidua after the original limits of the placenta had been determined.

In the *battledore placenta* the cord is inserted at the margin of the placenta (Figs. 98 and 99, E). In *placenta velamentosa* the placenta has developed at some distance from the original attachment of the umbilical cord, and the blood-vessels divide on the surface of the membranes to reach the placenta (Figs. 98 and 99, F).

Placenta prævia is due to the development of the placenta in the region of the lower uterine segment instead of in the upper portion of the body of the uterus. It is of great clinical significance (p. 573). So also may be insertion of placenta at a tubal angle (Angular Pregnancy, p. 361).

Abnormalities in Size and Weight.—The normal placenta measures about 8 inches (20 cm.) in diameter and 1 inch (2.5 cm.) in thickness. Its weight is normally about 1 lb. (500 grams), roughly one-sixth of the weight of the child. In the ordinary variations in size, the thickness varies inversely with the area. The placenta in syphilis (p. 317) is heavy and may amount to one-fourth or even one-half the weight of the child. In albuminuria it may be very large, and in cases of general dropsy of the foetus (erythroblastosis foetalis) its weight may be as much as 3 to 4 lbs. In toxæmic conditions it is often enlarged.

Infarction of the Placenta.—The relative frequency of placental infarction has been differently stated. Whitridge Williams found white infarcts, measuring 1 cm. or more in diameter, in 63 per cent. of 500 placenta examined.

Placental infarcts consist of cubical, wedge-shaped or irregular areas, which stand out, because of their solid consistence, from the normal spongy tissue of the placenta (Fig. 100). In the majority of cases they lie with their base against the decidual surface. Sometimes an infarct may seem to lack this relation and to be imbedded in the centre of the placenta or even to be limited to the chorionic surface. In the majority of instances, however, on tracing them in serial sections, such infarcts are found to rest upon the decidual surface by a broad base.

Infarcts vary greatly in colour, and we can often in the same placenta recognise in different infarcts, or even in the same infarct, all gradations from a dark chocolate tint through brown and yellow up to white. It is thus easy to demonstrate that white and red infarcts, which formerly used to be classed as different entities, are in reality different stages in the evolution of the same structure. The more recent the infarct the darker its colour, while with increasing necrosis and the disappearance of the hæmoglobin in the red cells the paler does

the tissue become. Many infarcts of the red or purple variety are difficult or even impossible to recognise in the fresh placenta until the cut surface has been washed in running water. This washes out the blood from the healthy spongy areas of the placenta and brings into relief the more solid masses of hepatised tissue which constitutes the infarct, in which the blood in the intervillous spaces has undergone coagulation.

The essential changes in infarction are (1) coagulation of the blood in the intervillous spaces. This is probably the earliest change, and in many instances it is possible by its presence to detect by the microscope an infarcted area before it has undergone the consolidation changes which constitute the appearance of the fully mature state. The coagulation implies a stagnation of the blood circulating in the corresponding area, and as a result we get (2) collapse of this part of the placenta. The adjacent parts of the placenta press in upon it with the result that the villi become closely packed together to form a very



FIG. 100.—Infarctions of Placenta (white).

solid block of tissue. The conditions thus found in the placenta resemble those which occur in collapse of an area of the lung after obstruction of a bronchus. (3) Not infrequently there is found a marked expansion of the foetal vessels in the villi of the infarcted area. The significance of this is not clearly understood. (4) The tissues in the infarcted area undergo progressive necrosis with a progressive destruction of the blood pigment. This, as we have seen, explains the varying colour changes exhibited by the infarct during its metamorphosis. It would seem that from ten to fourteen days is required for the transformation of a chocolate-coloured (red) infarct into the white infarct.

The *aetiology* of infarction is not well understood. Of one thing we are certain, namely, that the death of the affected portion of placenta is due to local interference with the corresponding maternal circulation. At one time it was believed that obstruction in the circulation in the foetal villi was a primary factor. This view is negatived by the fact that the villi are dependent not upon the foetal circulation but upon the maternal circulation for their nourishment. There is incon-

trovertible evidence for this belief. Thus the trophoblast and the chorion are most active in their growth during the earliest embryonic stage when they are entirely dependent upon the maternal blood supply and before the foetal circulation has been established. Further, in diseased states of the chorion, such as hydatidiform mole, the chorionic elements live and proliferate in the absence of any foetal blood-vessels. A still more striking fact is that in many instances one can discover that the blood-cells in the foetal villi are still living and healthy, and apparently circulating in the foetal vessels even after there has occurred advanced infarction in the placenta.

The factors responsible for the interference with the maternal circulation are not understood. The fact that the placenta is a temporary organ which is but loosely attached to the uterine wall makes it peculiarly liable to be affected by shearing stresses that may interfere with its blood supply. Small areas of infarction, which may be multiple, and which are especially evident at the periphery of the organ, may be found in women who exhibit no other abnormality, and it has been suggested that these are merely an evidence of "senility" in a short-lived organ without possessing any clinical significance. It is recognised, however, that massive infarction (*placenta truffé*) is to be regarded as of definite pathological significance. It is found in two different classes of case with such frequency as to suggest the existence of some correlation. The first of these is habitual abortion and habitual still-birth. If the placenta is examined in such cases infarction is common, and it may be so massive as to provide an explanation of the foetal death. In view of the recent investigations on the efficacy of vitamin E in the treatment of habitual abortion it has been suggested that this vitamin is intimately required for the maintenance of the placenta and that its deficiency may lead to habitual abortion and still birth in women. The second clinical correlation to be recognised in connection with placental infarction is its association with pre-eclampsia and eclampsia. This association has been recognised for many years. By most observers it is regarded as one of the manifestations of the toxæmic process, the necrosis of the placenta in this view falling into the same category of secondary phenomena as the hepatic necrosis of eclampsia. By other observers (Young) it is regarded as an evidence of a degeneration in the placenta of a more primary nature, and as pointing to a possible explanation of the placental origin of the toxæmic phenomena. It is known that in cases of accidental hæmorrhage the area of placenta subtending the retroplacental bleeding invariably undergoes massive necrosis (*vide* illustration, p. 587).

Tumours of the Placenta are very uncommon. Most of the tumours of the placenta belong to the class of *chorio-angiomata*, and consist of masses of chorionic villi with immense hypertrophy and hyperplasia of the terminal vessels. In some the dilated vessels predominate, while in others the connective tissue is more conspicuous. In many cases

the tumour is connected with the chorion by a small pedicle and has developed from a single villus. If these tumours are small, they are of little clinical importance; but in some cases reported the tumour has been large, even as large as a foetal head at term. Recent investigators have pointed out the interesting fact that the large tumours have generally hydramnios as an accompaniment.

Other varieties of tumours have been described. The *myxoma fibrosum* was considered by Virchow to be the most common placental tumour. This tumour is composed for the most part of fibrous tissue, and areas of myxomatous degeneration are scattered through it. The tumour looks like a large white infarction.

Malignant tumours of the placenta, of sarcomatous and carcinomatous types, have been described, in each case associated with a malignant neoplasm in the mother. Eardley Holland has described an enormous black placenta which had melanotic sarcomatous growth in the maternal spaces and in the vessels of the villi. The mother died three months later. The child was born apparently healthy, but died at the age of eight months; its liver contained nodules of melanotic sarcoma. This is an example of transplacental implantation of malignant growth from mother to foetus. One of the authors (J. Y.) has recently had a case in which massive involvement of the intervillous spaces with malignant cells was found in association with a hypernephroma of the kidney.

Cysts of the Placenta.—These are of purely pathological interest; they seldom exert any influence on the progress of pregnancy. They may occur on the foetal surface or in the depths of the organ. They vary in size from a cherry to a lemon. The contents are usually clear and transparent, but may be grumous. On the foetal surface they arise as spaces inside the chorionic membrane by the special development of a group of the trophoblastic cells of Langhan's layer, which form part of that membrane. The cysts in the substance of the placenta usually appear in the centre of an infarction, formed either from the breaking down of the fibrous tissue in the infarction, or by a special development of the trophoblastic cells which occur in the walls of the villi.

Œdema of the Placenta.—This condition occurs in syphilis of the foetus, and in foetal dropsy (erythroblastosis foetalis, p. 315).

Inflammation of the Placenta.—What used to be called *placentitis* is now recognised as infarct formation. The small cysts with grumous fluid, described as placental cysts above, were formerly regarded as abscesses.

Acute inflammation of the placenta is very rare, but may occur as an extension of an inflammatory process from the decidua, due to (a) an exacerbation of a pre-existing gonorrhœa, or (b) an acute infection due to the gonococcus or other pyogenic organism. Abscess formation may occur as a manifestation of a general septicæmic infection of the

mother. In cases of prolonged labour pyogenic organisms may invade the foetal surface of the placenta, and, entering the chorionic vessels, may give rise to general infection of the foetus.

Chronic inflammation of the placenta may occur as a development of a chronic endometritis, and lead to an adherent placenta (p. 555).

Syphilis of the Placenta.—This condition is dealt with under Syphilis of the Foetus (p. 317).

Tuberculosis of the Placenta.—A tuberculous lesion in the foetal part of the placenta is rare, but it may occur in the decidual portion. Occasionally such lesions have been identified in the chorion, and even in the stroma of the villi. In generalised tuberculosis of the mother, tubercle bacilli may be found in the foetus without any lesion being discovered in the placenta. Since the bacillus has been found in the foetal portion of the placenta, congenital tuberculosis does not seem an impossible condition (p. 279).

Calcareous Degeneration of the Placenta.—Calcareous particles are frequently found on the maternal surface, which feels gritty to the touch. There may be flat plaques so abundant as to make the surface of the organ look like sandpaper. Calcareous deposits occur in association with degenerative processes in the later months of pregnancy. Genuine fatty degeneration does not occur.

Abnormal Adherence of the Placenta.—This condition is more often due to faulty contractions of the uterus than to actual organic adhesions. There is, however, a variety in which the placenta is as it were plastered on the uterine wall—*placenta accreta*. It is the result of primary atrophy of the endometrium, with consequent absence of the decidua basalis. It is a very rare condition, and owing to the difficulty in removing the placenta a very grave one (p. 555).

ABNORMALITIES OF THE UMBILICAL CORD

To avoid repetition, abnormalities connected with the umbilical cord are considered in Chapter XXIX (p. 503).

DISEASES OF THE FŒTUS

Malformations of the Foetus.—These malformations are only of pathological interest, except in so far as they may be a cause of dystocia. A few of the more common types are illustrated in the section dealing with that type of dystocia.

Foetal Dropsy.—The condition has received very special attention in recent years in connection with erythroblastosis foetalis (hydrops foetalis, icterus gravis) which is liable to occur in Rh negative mothers (p. 565) if the foetal blood is Rh positive (acquired from father). Naturally the disease tends to recur in subsequent pregnancies. If and when the anti-agglutinins in the mother's serum can be combated by iso-immunisation then erythroblastosis foetalis will be preventable.

Fœtal Syphilis.—Syphilis, while a less important cause of abortion than was formerly believed, is probably the most frequent cause of premature labour—*i.e.* labour after the twenty-eighth week of pregnancy. This occurs most frequently when infection has been present before conception, and has been untreated or incompletely treated. The fœtus is almost always still-born and macerated. While it has been claimed that at least 40 per cent. of all macerated fœtuses are syphilitic, maceration is not due to syphilis, but simply to the fact that the dead fœtus has been retained for some time in the uterus. Should pregnancy go to full term, the child may be (a) still-born and macerated; (b) it may be alive and show the obvious signs of congenital syphilis; (c) it may appear quite healthy, though the syphilitic stigmata will probably appear in a week or two.

When inoculation has occurred a long time before conception and the condition has been energetically treated, the child will probably be healthy and show no sign of the disease.

When inoculation occurred at conception or early in pregnancy and the mother is untreated, the child is almost invariably syphilitic, but if she is treated very thoroughly the fœtus may escape (p. 280). If inoculation did not occur until the later months, the child may escape completely.

If the mother is suffering from syphilis at the time of conception, the transmission probably takes place direct to the ovum. If inoculation occurs at conception, or in the early months of pregnancy, the transmission is through the placental site.

Many clinicians now discredit the possibility of paternal transmission. It was on the possibility of paternal transmission that Colles' law was stated—namely, that when a syphilitic father has no infective lesion at the time of coition, the mother may give birth to a syphilitic child without becoming infected herself. It is much more probable that the mother has an infection herself, the virus being present in an attenuated form: the fact that she can nurse the child afterwards without risk of infection to herself is due to the immunity which she possesses in view of her previous infection.

THE SYPHILITIC FŒTUS.—The fœtus is undersized, with little or no subcutaneous fat.

(a) When the fœtus is born alive, the skin is dry, with a peculiar drawn appearance and a greyish hue suggestive of the facies of a very old person. It is very brittle, especially at the flexor surfaces of the joints. Abrasions occur very easily, and expose the corium. The skin shows copper-coloured areas; that on the palms of the hands and soles of the feet is thickened and glistening like a washerwoman's hands. These surfaces may have pemphigoid vesicles. Even when the child appears healthy, in a few days it may begin to snuffle, and a rash appears round the margin of the anus and buttocks.

(b) When intrauterine death has occurred, the fœtus macerates

rapidly. Skin peels off on the slightest touch, exposing the discoloured corium underneath. Among macerated foetuses, about 40 per cent. are syphilitic.

Lungs.—Round cell infiltration is present and the alveoli are almost closed.

Liver.—The size is increased, the organ weighing an eighth or a tenth of the whole body, instead of a thirtieth. The condition is a hypertrophic cirrhosis. There is an increase in the connective tissue with round cell infiltration.

Spleen.—This organ is enlarged to two or three times its normal size, and, like the liver and lungs, shows interstitial fibrosis.

Kidneys.—They show interstitial nephritis.

Cranial Bones.—They are thickened and closely adherent to the dura mater.

Epiphyseal Changes in the Bones.—The normal epiphyseal lines become very ragged and irregular; this is especially pronounced at the lower end of the femur and the upper end of the tibia. In advanced cases there is often considerable softening, and there may be complete separation of the epiphyses. The lesion causing these changes is an osteochondritis: the cartilage cells are not arranged in parallel columns, but all the tissues are irregularly arranged with extensive leucocytic and small-celled infiltration. These lesions can be demonstrated by radiography—a most useful aid to diagnosis.

The Spirochaeta Pallida.—The organism is rarely found before the sixth month, but can be easily identified after that time in liver and spleen, but especially in the adrenals, where it occurs in 97 per cent. of cases.

THE SYPHILITIC PLACENTA.—It is always relatively, and frequently absolutely, increased in size, and may equal the weight of the foetus instead of being only one-sixth. When the foetus is born alive, the placenta has a pale colour, but may appear otherwise normal. If the foetus is macerated, the organ has a dull, greasy appearance and shows definite changes.

Microscopically the villi have lost their arborescent appearance and are thicker and club-shaped. There is a marked decrease in the number of vessels, which, in advanced cases, disappear almost entirely. This results partly from an *endarteritis obliterans*, but principally from a dense proliferation of the stroma-cells, which lose their normal stellate appearance and become round or oval, and closely packed together. In section the individual villi are greatly increased in size and have almost no blood-vessels. They are filled with closely packed rounded or oval cells. The identification of the *Spirochaeta pallida* in the placenta is very difficult, even in cases in which it is easily found in the foetal tissues.

Structures resembling gummata have been described in the decidual portions of the placenta, but many workers state that these are

simply hyperplastic conditions. No gummata are found in the foetal portion.

THE UMBILICAL CORD.—The walls of the vessels are oedematous, with leucocytic infiltration between the muscle fibres. Similar changes occur in the *tunica adventitia*, and the *intima* is thickened.

A positive Wassermann reaction from the blood of the umbilical cord taken at birth has been found to be unreliable in the diagnosis of congenital syphilis. Many children giving such a reaction prove to be perfectly healthy, and it has been suggested that the substances which cause this reaction are transmitted from the maternal to the foetal blood.

INTRAUTERINE DEATH

Death of foetus in the early months is considered under abortion, in the next chapter. Many of the causes which bring about this early death are also responsible for death occurring in the later months. On the side of the mother, toxæmias of pregnancy, chronic nephritis, syphilis, acute fevers, accidents, etc.; and on the foetal side the conditions referred to in this chapter may be mentioned.

Very interesting are the examples of *repeated intrauterine death* at a fixed period of pregnancy, generally a few weeks before term. Although a definite cause for such periodic deaths can sometimes be discovered in foetus or placenta, in many instances this is not possible. There is the possibility—indeed, probability—in some cases that disturbed hormonal balance may be the cause. It is pointed out in the next chapter that this is a very important factor in causing abortion; but at the moment our knowledge of hormonal activities in the later months of pregnancy is much less exact than in respect of the earlier weeks. The children are often quite well developed. Obviously in all cases a thorough investigation of the mother should be made and a most careful examination of foetus and placenta carried out.

In cases of repeated intrauterine death the child may often be rescued by inducing labour immediately before the usual date of death (p. 733). The safer procedure in some instances is to employ Cæsarean section. The children in cases of this nature are often feeble in health and stand badly the strain of labour. Unfortunately, we have no means at present of determining when the life of the foetus *in utero* is becoming endangered (*vide* remarks on Vitamin E, p. 147).

The determination of intrauterine death in the early months of pregnancy may be difficult. Absolute proof is where the uterus does not show any increase in size during the space of four or five weeks. The Aschheim-Zondek or Friedman test is a useful guide, but the reaction remains positive so long as there are any living villi, and that may continue for two to three weeks after the death of the embryo.

In the later months, cessation of foetal movements and the absence of foetal heart-sounds are indications of foetal death. The difficulty

in hearing the foetal heart may be considerable even in the later months. Sensations, such as a feeling of weight or of coldness in the lower part of the abdomen, and a feeling of malaise, though they often occur in cases of foetal death, cannot be relied upon if they form the only evidence. When death occurs the uterus decreases in size from the absorption of liquor amnii, and the breasts become more flabby.

By radiography it is possible to make a definite pronouncement of death of the foetus in the latter half of pregnancy. By twelve to twenty-four hours shrinkage of the cranial contents occurs and overlapping of the bones takes place—Spalding's sign (*vide* Chapter LX).

The treatment of this condition in the early months (p. 332) is dealt with under Missed Abortion for death and under Induction of Labour when death occurs in the later months (p. 733).

POST SCRIPT

Although it is impossible in the meantime to make any definite pronouncements on the subject of the Rh (p. 565) and other factors of a similar nature in the blood of mother or father as causes of foetal death (other than deaths due to erythroblastosis), there is reason to hope that further investigations may throw light on the causes of death in a number of still-births which are at present inexplicable.

CHAPTER XVI

ABORTION—HÆMORRHAGES IN THE EARLY MONTHS OF PREGNANCY—OTHER HÆMORRHAGES OF THE EARLY MONTHS—PREMATURE LABOUR

ABORTION OR MISCARRIAGE

ABORTION is defined as the expulsion of the product of conception before the viable age, which is generally accepted as being twenty-eight weeks or seven lunar months. Where the foetus is expelled after this date but before full term, the condition is referred to as "Premature Labour."

Until recent years a distinction was made between the two terms *abortion* and *miscarriage*, the former term being employed when the fertilised ovum was expelled before the sixteenth week and the latter when it was expelled between the sixteenth and twenty-eighth weeks. Such a distinction has been generally given up, and the two terms are used indiscriminately, with the exception that abortion is the more technical and miscarriage the more popular one. From the point of view of prognosis, however, the distinction is important as the mortality rate is much higher following miscarriage than abortion.

Frequency.—It is impossible to estimate exactly the incidence of abortion. An enormous number of early abortions are unrecognised by patient or medical attendant, the minute fertilised ovum and blood passed being considered a delayed or premature menstrual period. As regards definitely recognisable abortions, a considerable number of estimates have been presented in recent years; but it is in the region of 1 : 5 labours. Criminal abortions brought on by drugs (abortifacients) or instruments are on the increase—this naturally vitiates all figures and estimates of spontaneous abortions.

ÆTIOLOGY

As teachers of obstetrics we have found that the impression in the minds of many students is that abortion occurs from induced uterine activity. Now the uterine contractions or pains which are a feature of abortion are generally secondary to hæmorrhages at the site of attachment of the ovum and/or death of the ovum—they are not the primary cause of the detachment. Only occasionally does uterine activity precede and cause detachment. Hence the clinical experience

that abortifacients, employed criminally, whose purpose is to cause the death of the ovum are much more effective than those directed primarily to stimulating uterine action.

A common classification of the causes of abortion is to divide them into (a) Maternal, (b) Fœtal, (c) Paternal. In common with most classifications it has its defects; but it furnishes a simple grouping for the consideration of this important subject.

(a) MATERNAL.—*Hormonal Influences*.—Information furnished by investigations in biological laboratories on imbedding of the zygote in lower animals, and the hormonal influences concerned, has naturally led to a new orientation regarding the causes of abortion in the human species. This does not imply that simpler causes, based on clinical experience—e.g. accident, retrodisplacement of uterus, to which much importance was attached formerly—should not still be considered as influencing factors in individual cases. It does imply, however, that in many instances we must search deeper and utilise the knowledge biological investigators have furnished, bearing always in mind the possible error of attaching too much importance to analogies between lower animals and man and even between the primates and man.

We have already seen (p. 57) that the uterine mucosa is periodically stimulated to activity by œstrin and that the "running" is then taken over by *progesterin* (the hormone elaborated in the cells of the corpus luteum). This begins to take effect from twenty-four to thirty hours following ovulation. Should pregnancy occur, increased activity and more pronounced hypertrophy of the mucosa to form the decidua take place. In the lower animals, if this hormone (progesterin) is withdrawn by excision or destruction of the corpora lutea (for there are several in the lower animals), or by oöphorectomy very early in pregnancy, the decidua atrophies, death of the ova takes place and abortion follows. It has also been found that the administration of *progesterone* (extract of corpus luteum) to such animals prevents abortion in a large proportion of cases. In the human species, however, removal of the influences of progesterin does not necessarily lead to abortion—as proved by the clinical experience that pregnancy may continue even after double oöphorectomy in early pregnancy, where this operation has been necessary owing to cystic disease of the ovaries. Again, although there is evidence that the administration of progesterone may be beneficial in preventing *habitual* (p. 334) or even *threatened* abortion its influence is not so definite in the human species as in the lower animals.

Then there is the question in the human species as to how far the early chorionic villi and later the placenta assume responsibilities for supplying hormones necessary for the continuance of pregnancy. A very large proportion of abortions occur from the eighth to the twelfth week when the placenta is becoming fully developed, while the corpus luteum is becoming less active. Maladjustments at this period when

the placenta may be taking over may play an important part; but with the inadequate knowledge at present available speculation should not be pushed too far.

Furthermore, there are the activities of anterior and posterior lobes of the pituitary gland, of the thyroid, of the parathyroids, and of the suprarenals, all of which, as we have seen, are stimulated to increased activity by the pregnant state. In faulty co-ordination of this intricate physiological mechanism lies, in all probability, the cause of early abortion in most instances.

Vitamin Deficiency.—It has not been determined how far a deficiency in vitamin E can cause death of embryo and abortion; but it would appear that the administration of "wheat germ" rich in vitamin E is beneficial in the treatment of repeated abortion (p. 334).

Implantation Site.—Another influencing factor is the implantation site of the zygote. Unfavourable sites are the three orifices. Implantation at the tubal orifice (Angular Pregnancy, p. 361) or implantation in the neighbourhood of the os internum (Placenta Prævia, p. 575) predispose to abortion.

We now come to the causes which, prior to our knowledge regarding hormonal influences just referred to, were presented as the chief ætiological factors. They are most important and in many instances are the primary cause. They act in the main by inducing hæmorrhages at the site of implantation (decidua basalis and later placenta), as mentioned in an earlier paragraph.

Poisons.—The toxins of the toxæmias of pregnancy are probably the most important. This is particularly evident in the case of chronic nephritis, although in recent years it has been found that intrauterine death and premature labour are more common sequelæ than abortion in respect to this condition.

Early in pregnancy the ordinary tests for toxæmia are of little avail—at present we have no means of determining the presence of minor toxæmic conditions at this stage.

Next come poisons of the specific fevers, such as smallpox, typhus, enteric, pneumonia, influenza, etc. Syphilis comes into this group; but in respect to this condition intrauterine death and premature labour are more frequently the sequelæ.

Lastly, some metallic poisons, more especially lead, deserve mention. In times past it was found that women workers in lead suffering from chronic lead poisoning were peculiarly prone to abortion, because lead has a lethal effect on the ovum. Lead in some form is a very common ingredient of "abortifacient" pills (p. 324).

Diseases of the Reproductive System.—It is a little difficult to assess the importance of pathological conditions of this system. The most common local lesions in the reproductive organs are adenoma of endometrium, chronic subinvolution, and backward displacement of the uterus. Adenoma (glandular endometritis (?), p. 920) is closely related

to disturbed ovarian function (p. 788)—the very much hypertrophied mucous membrane is not an ideal resting-place for the fertilised ovum. The same applies to chronic metritis or subinvolution of the uterus—in such conditions, but for a different reason, the mucosa is not healthy and, in consequence, the zygote is liable to become detached. Backward displacement, as it favours congestion of the uterus and is so commonly associated with endometritis or adenoma of the mucosa, is also a common cause of abortion. Fibromyomata of the uterus may also be mentioned; another cause is deep cervical laceration.

Accidents.—Falls, injuries or other accidents are sometimes the direct cause. Very frequently, however, one of the conditions already referred to is the primary factor. Accident as a cause is placed, therefore, further down the list than the others, because we wish to impress upon our readers that it is not so important as those previously mentioned, although women themselves attach great importance to accident, strain, or fall having been the cause.

Under this heading, reference must be made to *repeated coitus* as the exciting cause in some instances. This explains many of the cases of early miscarriage in the newly married. It is no uncommon occurrence for a first pregnancy to terminate in abortion because of the recurring congestion of the reproductive organs associated with too frequent intercourse.

Diseases in Systems other than the Reproductive—viz. *Digestive, Excretory, Nervous, Vascular and Respiratory.*—Undoubtedly disturbances in any of these systems may directly or indirectly cause abortion. The most important are disorders of the excretory and digestive systems, for they are so commonly associated with the toxæmias already referred to. Reference has already been made to chronic renal disease. Disturbances of the nervous system, such as fright, extreme emotion or graver diseases, such as chorea, may be causative factors: but in the case of fright and emotion hormonal influences may play an important part. In the vascular system chronic valvular disease, and in the respiratory system chronic bronchitis, may be mentioned—they favour congestion of the uterus.

Habit Abortion.—Some individuals have an extremely irritable uterus—the least fright, excitement, etc., is sufficient to induce an abortion. As these abortions keep on recurring the condition is referred to as “habit abortion.” The same thing occurs in the lower animals—breeders of horses, cattle, etc., occasionally encounter mares or cows in whom a continuation of pregnancy is impossible. Disturbed hormonal balance, vitamin E deficiency and/or a slight underdevelopment of the uterus are probably the underlying causes.

Epidemic Abortion.—This condition occurs in cattle, and is caused by *Bacillus abortus* of Bang. It has been claimed by some that this organism may also cause abortion in women—there is no proof, however, that this is the case.

(b) **FŒTAL.**—Death, disease, abnormalities, injury are the principal causes of abortion on the side of the fœtus. As regards death of fœtus, maternal abnormal conditions, already referred to, are all-important influencing factors. In respect to disease, syphilis has been mentioned. Lastly, it has been found that in a great number of early *spontaneous abortions* (possibly 10 per cent.) *the embryo is malformed and some form of monster would have resulted had pregnancy continued.*

(c) **PATERNAL.**—Paternal factors do not seem to be of much consequence except in the case of syphilis. The part played by debility, old age, chronic alcoholism and chronic lead poisoning is still undetermined.

Criminal Abortion.—Criminal abortion is generally induced by the taking of drugs (abortifacients), such as the salts of lead, quinine, ergot, savine, pennyroyal, or by the introduction of instruments into the cervix. *Drugs taken with the purpose of stimulating the uterus to activity (oxytocics) are very uncertain in their action, even when taken in large doses. The salts of lead, which produce a colliquative necrosis of the decidua resulting in death of the ovum, are more certain.* Lead is the chief ingredient of most abortifacient pills, unfortunately so freely advertised in the less reputable press. If instruments are used by the patient herself, very severe injuries may be inflicted upon the vagina, bladder and rectum; in some instances, where knitting-needles, hair-pins, etc., have been employed, the pouch of Douglas has been injured. A doctor or nurse inducing abortion with criminal intent generally employs a uterine sound. Because the operation is performed secretly, and very often without cleansing the vulva and vagina or even sterilising the instrument, infection of the uterus frequently follows, and proves fatal.

Criminal abortion is definitely on the increase. The subject is being much discussed at present. It is claimed by many that this increase in great part explains the failure to reduce puerperal mortality from sepsis (p. 760). It is difficult to determine to what extent criminal abortion is on the increase. Very seldom will patients resident in hospital, for example, admit guilt; and just as seldom are wounds in vagina or cervix discovered. All evidence goes to prove that the purchase of drugs which have the reputation of being abortifacients is on the increase. It would appear that an increasing number of married women for financial and economic reasons are desirous of terminating pregnancy—*criminal abortion is not confined to the unmarried.* But while a large number of married women have no compunction to taking drugs, comparatively few, in this country at least, are prepared to go the length of having the pregnancy terminated by mechanical means by anyone who performs this illegal operation.

Therapeutic Abortion.—By therapeutic abortion is understood

the removal of the products of conception in cases in which the continuance of pregnancy is deemed to be a danger to life or prejudicial to health. No definite conditions are laid down for the employment of the operation : each individual case is judged on its own merits. It should never be performed unless after consultation with one or more colleagues, who must be in agreement that the operation is advisable. Strictly speaking, the operation has not been legalised, but it has been generally accepted that the induction of abortion is permissible under certain circumstances and for certain conditions (p. 737).

The law governing the induction of abortion is contained in Offences Against the Person Act of 1861 (Sections 58 and 59)¹ ; but as a result of the Bourne Case it is accepted that if the health of a patient is endangered by a continuance of pregnancy induction of abortion is justified, although not technically legalised. The writer (J. M. M. K.) is definitely opposed to defining by Act of Parliament the cases or circumstances in which abortion might be legalised. Far better is the present position when the matter is undefined and left to the considered opinion of two or more doctors who, if they consider the life or future health of the patient is jeopardised, take the responsibility of performing the operation ; and if by any chance they are taken to task by any responsible authority are unperturbed and defend themselves for the action taken. The induction of abortion on compassionate grounds cannot be discussed here—it is definitely illegal, although in the case of rape on a young woman there is much to be said for it. Here it can always be pleaded that the life and health of the young person would be endangered by allowing pregnancy to continue.

SYMPTOMS AND TREATMENT OF THE DIFFERENT VARIETIES OF ABORTION

Abortion is most usually encountered in the second or third month, and is especially prone to happen at times which would have been menstrual periods had no pregnancy existed. The reason for this is that, although menstruation is suppressed, the cyclic changes associated with it are not entirely arrested. Then there are also the hormonal changes about this period already referred to (p. 321).

The three symptoms of abortion are (1) hæmorrhage, (2) pain and (3) dilatation of cervix.

The degree of hæmorrhage is very variable. In some cases it may be extreme, the patient becoming quite blanched from loss of blood. Naturally, other features of hæmorrhage are present, such as collapse, faintness, rapid pulse, etc., in proportion to the amount of blood lost.

The degree of *pain* also varies, and in very early abortions may be slight. It generally succeeds the first symptom of hæmorrhage, which is due to the detachment of the ovum.

The third symptom, *dilatation of the cervix*, occurs sooner or later if the ovum is expelled; but where the ovum is retained in the uterus, dilatation may be comparatively slight.

In the early months the whole ovum may come away entire, but owing to the fact that at this stage fusion between decidua capsularis and decidua vera is not complete, it not infrequently happens that the ovum with its shadowy villi is expelled and the decidua vera left

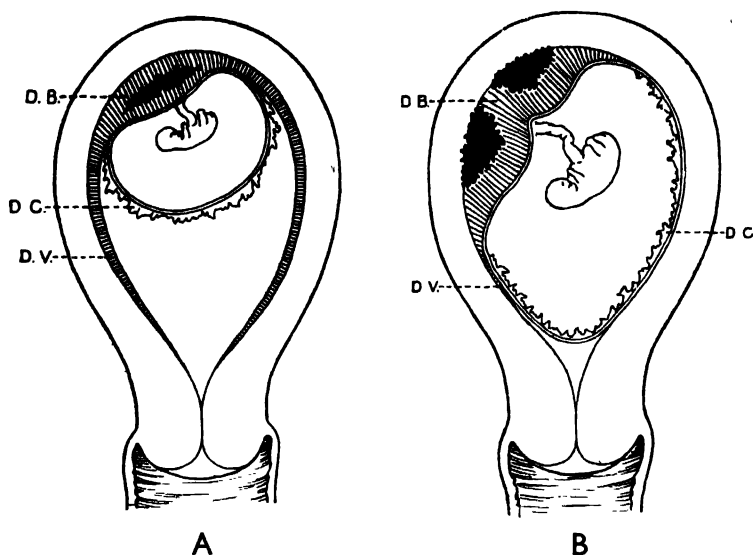


FIG. 101.—Showing Hæmorrhages into (A) Decidua Basalis; (B) under Placenta.

D.B. Decidua Basalis.

D.C. Decidua Capsularis.

D.V. Decidua Vera.

behind. Later, after fusion of the layers of decidua, the whole mass generally comes away entire, although in most instances portions of decidua are retained (Figs. 101, 102).

When abortion occurs still later after the placenta is well formed, say from the fifth month onwards, the rule is for the membranes to rupture and the fœtus to be expelled, followed by expulsion of the placenta. Unfortunately the placenta is very frequently retained in whole or part, and has to be removed manually. In a few cases the unruptured sac with fœtus and placenta is expelled entire.

If the early ovum is retained for any length of time in the uterus, it may undergo dissolution, sometimes no trace of the embryo being found. More commonly, however, numerous hæmorrhages occur around and between the membranes. To this condition the term "blood or carneous mole" is applied (p. 333).

The following is the usual classification of the varieties of abortion as encountered clinically :—

Varieties {	(1) Threatened.	
	(2) Inevitable	(a) complete. (b) incomplete.
	(3) Missed.	

1. Threatened Abortion.—Pain is seldom pronounced. Hæmorrhage is moderate in amount, blood coming away in a scanty trickle or in the form of small clots. Dilatation of the cervix is only slight. Generally, if there is much bleeding and dilatation of the cervix, abortion is inevitable.

In many instances one cannot decide at first whether abortion is threatened or inevitable. Therefore in doubtful cases expectancy is the treatment. In addition, means are employed to quiet the circulation and to arrest uterine activity. The patient should be kept in bed; this is by far the most important detail in the treatment. Diet at first should be restricted to simple fluids or easily digested foods, such as Benger's Food, Allenbury Diet, etc. It is advisable that fluids should be given cold or only moderately heated. The sedatives employed are opium by the mouth in the form of Battley's solution (25 minims), morphia hypodermically ($\frac{1}{4}$ to $\frac{1}{2}$ grain) or morphia suppository ($\frac{1}{4}$ to $\frac{1}{2}$ grain). The addition of a very small dose of hyoscin ($\frac{1}{80}$ grain) is often useful. Progesterone and vitamin E may be useful.

In what might be termed more chronic cases—*i.e.* where slight bleedings continue or recur—bromide of potash (25 grains), or extract of viburnum prunifolium (2 grains), may be given thrice daily. It is questionable if the administration of progesterone or a diet rich in vitamin E has much effect if abortion has reached this stage. The treatment gives better results in the prevention of recurrent abortion, and threatened abortion in the very early stage.

Strong purgatives must be avoided. In the acute stage the bowel may have to be emptied by small enemata of soap and water, glycerine injections or glycerine suppositories; but it is better if enemata can be dispensed with and the bowels moved by liquid paraffin or ordinary laxatives.

The duration of confinement to bed, after arrest of symptoms, will depend upon circumstances, but during "period" times, when abortion is specially liable to occur, rest in bed must be insisted upon. Sometimes it may be necessary to keep the patient in bed during the greater part of pregnancy (*vide p. 334*).

The prospects of preventing abortion if pain and hæmorrhage are fairly well marked is not very good. In only about 30 to 40 per cent. of cases does the pregnancy continue.

2. Inevitable.—(a) COMPLETE.—In this form of abortion the entire

contents—embryo, membranes and placenta—are expelled. With the expulsion there is hæmorrhage, severe pain and marked dilatation of the cervix. Whether an abortion is complete can be determined by examining the expelled mass, but unfortunately it is often lost; sometimes, also, it is difficult to tell if all the membranes have come away, and especially if the decidua vera has been expelled. It is the practice of the writers of this textbook in cases of doubt to explore the interior of the uterus with the gloved forefinger, to curette lightly the surface with a large blunt curette and to douche out the cavity with an anti-septic lotion. To-day many obstetricians advise against this procedure, as they think that the risks of injuring the uterus and conveying in-

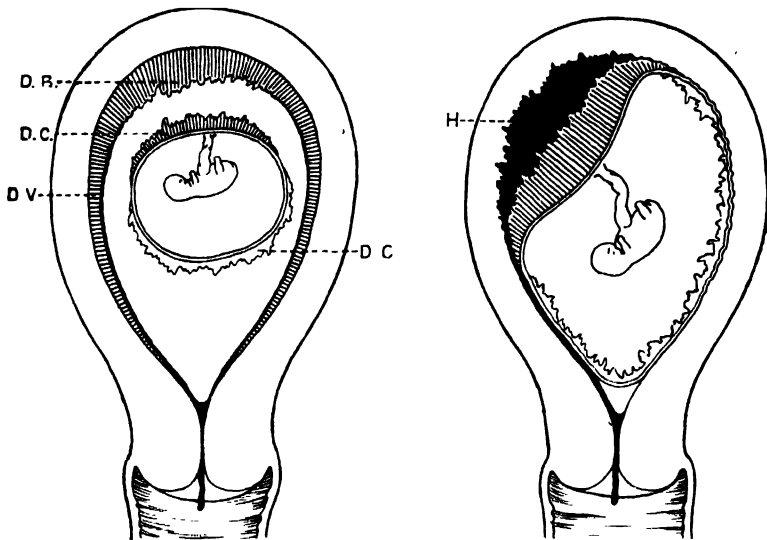


FIG. 102.—Complete Separation of Ovum; left-hand figure shows Ovum with Decidua Capsularis (D.C.) but Decidua Basalis (D.B.) and Decidua Vera (D.V.) left. Right-hand figure shows Ovum and all the Membranes separated by Hæmorrhage (H.) (complete abortion).

fection into it outweigh the benefit of removing small decidual debris. They recommend that pituitary extract ($\frac{1}{2}$ to 1 c.c.) should be given intramuscularly; and that half a teaspoonful of fresh liquid extract of ergot (thrice daily) should be given orally for a couple of days.

(b) INCOMPLETE.—The great majority of abortions encountered in practice are incomplete, but the portion retained is very variable—it may be only a few shreds of membrane, or practically the whole ovum.

In this variety, if the bulk of the ovum is retained, hæmorrhage continues, the os remains dilated and uterine colic or abdominal uneasiness persists. But where only a small portion of the ovum is retained, hæmorrhage may be slight and occur only at intervals, uterine colic disappears and the cervix becomes closed. As the partially

emptied uterus may not be markedly enlarged, the abortion may be erroneously considered complete. Such patients are prone to drift into a condition of ill-health from excessive periods and absorption of broken-down retained débris, or from septic absorption. Occasionally a placental polypus may form (p. 930).

Treatment.—Here the treatment is to remove the ovum or any portions of it left behind. If the cervix is well dilated, this may be done by the fingers introduced into the uterine cavity.

Sometimes with a well dilated cervix the ovum can be "expressed" just as the placenta is expressed after ordinary labour. To carry out this manipulation (Fig. 103) two fingers of the one hand are passed into

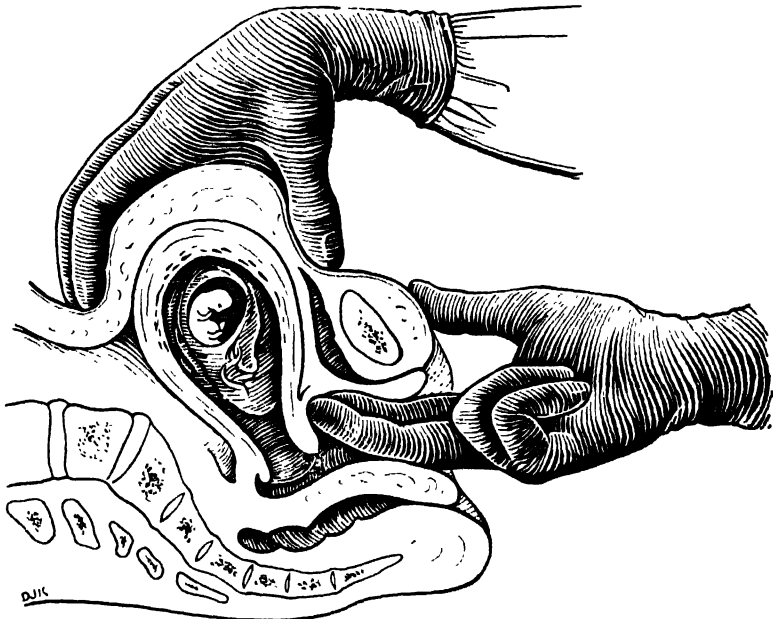


FIG. 103.—"Expressing" the detached Ovum.

the anterior fornix, whilst the other hand is placed over the abdomen. The uterus is then stimulated to contract by massage with the external hand, and when a contraction occurs the body of the uterus is compressed between the fingers in the vagina and the hand outside. Should the ovum be detached and free in the cavity, it will often come away quite easily. A very serious mistake is to pass the fingers in the vagina into the posterior instead of the anterior fornix; this may result in laceration of the posterior vaginal vault.

For dealing with this particular type of case there is no instrument so useful as the *ovum forceps* (Fig. 104), by means of which the ovum is grasped and removed *en masse* or piecemeal, as the case may be. Prior to introducing the forceps it is advisable to detach the ovum with the finger. This may be facilitated by grasping the cervix with

volvellæ, but in most instances it is more easily effected by pressing down the uterus with the external hand from above. After the ovum is removed, the uterine cavity may be lightly curetted with a large blunt curette, and washed out with normal saline solution (115° F.). If the operation has to be performed in the patient's home, and under unfavourable conditions, curettage should be dispensed with (*vide* p. 328). The operations of curettage and intrauterine douching are described in Chapter LIV). It is unnecessary to pack the uterus unless there is pronounced bleeding. Ergot or ergometrine should be given as the efficacy of pituitary extract early in pregnancy is limited.

The cases which cause the greatest trouble are those in which the



FIG. 104.—Ovum Forceps.

cervix closes on the ovum or fails to dilate sufficiently to permit of its removal by the means already mentioned. There are various methods of dealing with such cases.

A common procedure is to pack the cervix and the vagina with gauze. The gauze is removed after twenty-four hours, when, in some instances, the ovum comes away or can be easily extracted with the fingers or ovum forceps through the now dilated cervix. The great objection to the use of packing is the risk of infection. Unless the



By courtesy of Allen & Hanburys Ltd.

FIG. 105.—Laminaria Tent. Sealed glass tube containing alcohol or ether. The tent placed in cervix becomes swollen by absorption of moisture.

canal is very thoroughly cleansed, organisms are liable to be conveyed into the uterus with the packing. Besides it is seldom effective unless there are active uterine contractions, and then it is unnecessary. Only if there is fairly free hæmorrhage should packing be employed.

The procedure favoured by most obstetricians to-day is to administer pituitary extract (0·5 c.c.) at two-hourly intervals up to four to six doses. A half-teaspoonful of liquid extract of ergot should be given between the doses of pituitary extract and continued for two days. In most instances the ovum will be expelled, but if that does not occur the cervix should be dilated and the ovum removed.

To effect dilatation great caution must be exercised, as the cervix is easily torn. Should it appear inadvisable to proceed with metal dilators, the slower and more gradual dilatation by means of

sea-tangle tents may be employed (Fig. 105). The procedure is as follows: The cervix is steadied with volsella; one, two, or sometimes three, tents are then introduced side by side and the vagina packed with gauze. The tents are removed within twenty-four hours, when the cervix will be found sufficiently dilated to permit of extraction of the ovum. The subject of cervical dilatation is referred to more fully in connection with Induction of Abortion and Accouchement Forcé (pp. 737 and 741).

Septic Abortion.—In nearly all cases of incomplete abortion organisms can be grown from cultures taken from the uterus. In most instances the organisms are not very virulent; but in some they are.

The term "septic abortion" implies an incomplete abortion associated with rise of temperature and pulse and/or other manifestations of infection. It is obvious, therefore, that this particular condition requires most careful handling. *On the one hand*, active operative measures for the removal of the uterine contents may result in an extension of the infection beyond the uterus and even into the blood-stream. *On the other hand*, non-operative interference and trusting to spontaneous expulsion—aided, of course, by drugs—may permit a local and general extension of the infection owing to the delay involved.

It is not surprising, therefore, that there are two schools of thought—one which advocates early and active operative measures in all instances, and the other which advocates non-surgical procedures. At the moment the latter holds the field. We, the authors of this textbook, align ourselves with neither, as we consider that there are cases in which it is better to empty the uterus immediately and others in which less active measures may be employed with advantage.

It is generally accepted as a surgical principle that in any septic condition the focus of infection should be removed or treated locally whenever this is possible. Applying this principle in the present instance it is obvious that the removal of the septic uterine contents is most desirable. *If, therefore, the cervix is dilated* or very soft and easily dilatable with metal dilators, the septic uterine contents should be removed with ovum forceps. Ovum forceps are better than the fingers. Bimanual compression of the uterus, and this is necessary if the fingers are employed, causes a spread of the infection into the uterine wall. We prefer not to curette the uterus even with a blunt curette. Instead we advocate the introduction of a strip of gauze, soaked in a solution of glycerine and tincture of iodine (2 per cent.) or glycerine and Dettol (2 to 4 per cent.). It should be only loosely placed in the uterine cavity, as its purpose is for drainage. This gauze drain should be removed in twenty-four hours.

If, however, the cervix is found not dilated and rigid, partial dilata-

tion should be carried out gently, glycerine introduced (p. 652), and pituitary extract and ergot given, as already described, in the hope that by these means the septic contents may be expelled spontaneously. Should, unfortunately, this not occur within forty-eight hours, or should the patient's condition become worse in the interval, the risks of spreading the infection must be taken, the cervix dilated and the ovum removed. In all cases blood cultures should be made daily. The further treatment of puerperal sepsis is described elsewhere (p. 650).

Missed Abortion.—In this variety the ovum dies and is retained in the uterus. Occasionally symptoms of threatened abortion occur, but not infrequently there are no such symptoms. The ovum may be



FIG. 106.—Carneous or Fleshy Mole.

retained for many months, and indeed may not be expelled until what would have been "full time" had pregnancy run a normal course. The ovum presents a very typical appearance, and is known as the carneous, tuberous or fleshy mole (Fig. 106). From the illustration it will be observed that numerous hæmorrhages occur into the decidua and chorion. These raise the amnion in an irregular manner; hence the terms applied to the condition. In the amniotic cavity, which is often small, the minute embryo may be observed, but in many cases it has entirely disappeared.

DIAGNOSIS.—The diagnosis of "missed abortion" is often difficult, and sometimes can only be reached by waiting and observing if any change occurs in the uterus. If the uterus remains stationary as regards size and the subjective symptoms of pregnancy disappear, then we conclude that the ovum is dead. If, however, the uterus is

found to increase in size week by week, then we conclude that the ovum is alive and the pregnancy is progressing satisfactorily.

It is stated that after the death of the ovum there occasionally occurs for a day or two special activity in the mammary glands, but we have not confirmed this in all cases. Certainly before long the *mammæ* become more relaxed. *The Aschheim-Zondek test becomes progressively less positive after the death of the embryo or fœtus and is generally negative by two to three weeks*—as long as there are living villi the test may remain slightly positive. Some time after the death of the embryo there may occur a brownish vaginal discharge; but very rarely does a hæmorrhage occur until the uterus begins to expel its contents.

If full consideration is not given to the history of a case of this nature, a very serious error in diagnosis may be made and the enlargement of the uterus attributed to a fibromyoma. Such a mistake is hardly likely to occur if there is no uterine hæmorrhage, but if there is hæmorrhage the unwary might make this mistake and perform hysterectomy.

TREATMENT.—Two methods of treatment may be employed: (1) *Medical*—occasional doses of pituitary extract and œstradiol; (2) *Surgical*—removal of the ovum.

Medical.—Sooner or later the ovum is expelled, consequently some accoucheurs recommend leaving the case to Nature. Our readers will naturally ask the question: Is there any danger in leaving a dead ovum in the uterus? In this particular form of abortion, there is really no risk. The cervix is closed and, provided there is no discharge from the uterus, infection does not spread upwards. Further, the uterine vessels at the site of implantation of the ovum become thrombosed. We, however, do not wish to stress this method, more particularly as the retention of a dead ovum is repugnant to most patients. Leyland Robinson and Jeffcoate have found that in a considerable number of cases spontaneous evacuation of the uterus follows the administration of œstrogen. It is given intramuscularly in the form of œstradiol benzoate, 2 mg. every eight hours for five days. If abortion does not occur, quinine hydrochloride, 10 grains three-hourly and 0.5 c.c. pituitary extract hourly until six doses have been given should be administered. If the ovum is still retained the treatment should be repeated after the interval of a few days.

Surgical Removal.—This consists in dilating the cervix and removing the ovum. It will generally be found that dilatation is difficult if ordinary metal dilators are employed and the canal forcibly stretched. We therefore advise dilatation with dilators up to a certain point, and the insertion of one or more laminaria tents into the canal, as has already been recommended for certain cases of incomplete abortion. The alternative procedure of vaginal hysterotomy (p. 738) should be seriously considered if the cervix is very rigid.

PROPHYLAXIS AGAINST REPEATED ABORTION

Before leaving the subject of abortion, a word is necessary regarding prophylaxis, as very frequently the obstetrician is called upon to treat patients who have had repeated miscarriages. It is quite obvious that the first essential is to determine if possible the cause of the abortion and to remove it. Thus displacements should be corrected and a pessary introduced. If endometritis exists, the uterus should be disinfected (p. 923). If syphilis has been diagnosed by a positive Wassermann, then both parents must be treated as described (p. 281). Any other predisposing causes of abortion should be suitably dealt with and removed.

Unfortunately in many cases no definite reason can be assigned for the abortion. In some, undoubtedly, it is the result of an inherent fault in the ovum, endometrium and/or corpus luteum. It is satisfactory to be able to report a number of cases in which the administration of standardised preparations of corpus luteum—e.g. *progesterone*—has proved beneficial. To give such injections daily is inconvenient for both patient and doctor. The better arrangement is to give 10 milligrams weekly and a double dose during the week that would have been a "period" had pregnancy not taken place.¹

Within the last few years the use of *vitamin E* has been stressed. This may be administered in the form of "wheat serum concentrate" manufactured by Glaxo Laboratories. It is put up by this Company in the form of capsules (3 grains). One should be taken daily.

As pointed out also there is reason to believe that abortion may be due to some toxæmia which, with our present knowledge, is unrecognisable at so early a stage of pregnancy, but which favours hæmorrhage at the site of implantation. It is advisable, therefore, in all cases to keep the patient at absolute rest in bed, prescribe a suitable dietary, and increase elimination by carefully regulating the bowels and administering considerable quantities of bland fluids. Alkalis are specially useful, for they tend to lessen the coagulability of the blood and favour excretion of waste. With a view to improving general metabolism the administration of small doses of *thyroid extract* (0.192 daily) has been recommended. It is doubtful if the successes reported as following the administration of this drug are attributable to it or to other precautions insisted upon.

We are convinced that in cases of this nature, *rest in bed is the most important part of the treatment*; sometimes it is necessary to keep the patient in bed for the entire pregnancy. When such radical measures are employed, it is of great importance to the individual that diet and elimination should receive every consideration. While lying in bed she is prone to accumulate waste. Further, it will be found that massage of the legs, arms and chest supplemented

¹ Quantitative estimation (repeated at intervals if necessary) of *pregnandiol*, the form in which progesterone is excreted in the urine, may be helpful in assessing the functioning capacity of the corpus luteum (*vide* p. 169).

later by light resistance exercises are most helpful in maintaining muscular tone.

MATERNAL MORTALITY FROM ABORTION

In a textbook for students it is impossible to discuss this most important problem. Reference is made to the subject in Chapter XLI (p. 760).

OTHER HÆMORRHAGES IN THE EARLY MONTHS OF PREGNANCY

Several conditions associated with hæmorrhage may simulate uterine abortion in the early months of pregnancy.

ECTOPIC PREGNANCY.—This subject is considered in the following chapter.

IRREGULAR MENSTRUATION.—There are a few cases on record in which periodic discharge of blood has occurred during the whole of pregnancy. Such cases have been referred to earlier in this work. The more common form, in which there occurs a scanty period for the first month or two, has also been discussed (p. 163). But admitting such possibilities, it will generally be found that if hæmorrhage occurs in the early months of pregnancy, the condition resolves itself into (a) a threatened miscarriage; (b) ectopic pregnancy; (c) disease of cervix; or (d) placenta prævia (p. 573). One must therefore never rest satisfied with the diagnosis of menstrual hæmorrhage in the early months of pregnancy unless the conditions mentioned can be excluded, and the possibility of placenta prævia can never be excluded at this stage.

POLYPUS OF THE CERVIX.—A polypus of the cervix may be of either the mucous or fibroid variety (p. 927). It may be associated with irregular hæmorrhage of varying amount. When it projects through the external os it is easily recognised by touch and is readily visible through a vaginal speculum. If concealed in the cervix it may be overlooked.

The treatment is to remove the polypus.

CARCINOMA OF THE CERVIX.—Carcinoma of the cervix complicating pregnancy or labour is considered elsewhere (p. 295). It is readily recognised if situated on the external (vaginal) surface of the cervix, but where the tumour is intracervical, as shown in the accompanying illustration (Fig. 107), the diagnosis

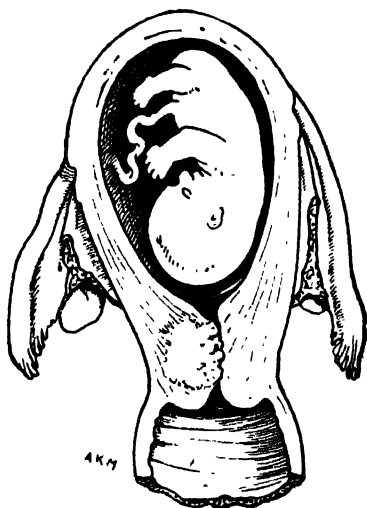


FIG. 107.—Intracervical Carcinoma (Early).

is difficult until the cervix is dilated, either artificially or during parturition, as hæmorrhage may be a late symptom (p. 968).

ULCERATION OF THE CERVIX.—In acute infective conditions of the vagina the surface of the cervix may become ulcerated and slight hæmorrhages may occur from its surface. Even when the acute condition has subsided a chronic erosion may be associated with irregular and slight bleeding.

Acute infection of the vagina and cervix (gonorrhœal) is discussed elsewhere (p. 281). Chronic infection is considered in the gynæcological section of this work (p. 906).

HYDATIDIFORM OR VESICULAR MOLE.—This condition is fully considered in connection with diseases of the ovum (p. 300). The outstanding feature in most instances is rapid enlargement of the uterus out of all proportion to the age of the pregnancy. We would remind our readers that the Aschheim-Zondek test in this condition is *pronouncedly* positive; this test should always be made if there is any suspicion of vesicular mole.

PLACENTA PRÆVIA.—This condition is fully considered in connection with hæmorrhages in the later months of pregnancy (p. 573), as it is generally at this stage of pregnancy that the bleedings first occur. Occasionally, however, hæmorrhages occur quite early in pregnancy. There is little doubt that this faulty implantation of the ovum is responsible for a considerable number of abortions. *In all cases in which repeated hæmorrhages occur during pregnancy, the possibility of placenta prævia should ever be kept in mind.*

METROPATHIA HÆMORRHAGICA.—This condition (p. 790) is sometimes associated with ten or twelve weeks amenorrhœa followed by prolonged bleeding.

PREMATURE LABOUR

Premature labour is the onset of labour prior to term but after the fœtus has attained the *viable age*. The twenty-eighth week has been fixed as the viable age, but it is very doubtful if children born premature to this extreme extent can survive. The writer of this chapter (J. M. M. K.) had experience of a case where as far as could be judged the age of the child (female) was thirty-two weeks; it weighed only 2½ lbs. at birth. The child grew up to be a fairly strong woman.

There is always a difficulty in determining exactly the age of a premature fœtus. The characteristic features at different ages have been described (p. 85). Here we would remind our readers that the length of the fœtus is the simplest guide to its age (p. 86). Radiography may be helpful.

Ætiology.—Two of the commonest causes of premature labour are (a) toxæmia of pregnancy, especially if associated with chronic nephritis

(p. 216), and (b) syphilis (p. 280). Other causes are plural pregnancy, hydramnios, placenta prævia, chronic subinvolution and tumours of uterus. In fact, all the conditions which predispose to abortion may also cause premature labour, including irregular endocrine activity—we have less exact knowledge regarding endocrine activity in the second half of pregnancy than in the first half.

Attention has been directed (p. 318) to the repetition of this occurrence in the later weeks of pregnancy associated very often with death of the foetus. Timely induction of labour may anticipate the occurrence and a live child be secured (p. 733).

Course of Parturition.—Premature labour runs very much the same course as an ordinary labour at term. Occasionally there is difficulty with the placenta, for although sometimes expelled almost immediately after the birth of the child, owing to its loose attachment, in other instances it has to be separated and removed manually because it is abnormally adherent to the uterine wall.

CHAPTER XVII

ECTOPIC PREGNANCY—PELVIC HÆMATOCELE—PREGNANCY IN RUDIMENTARY HORN—ANGULAR PREGNANCY—PREGNANCY IN DIVERTICULUM OF UTERUS

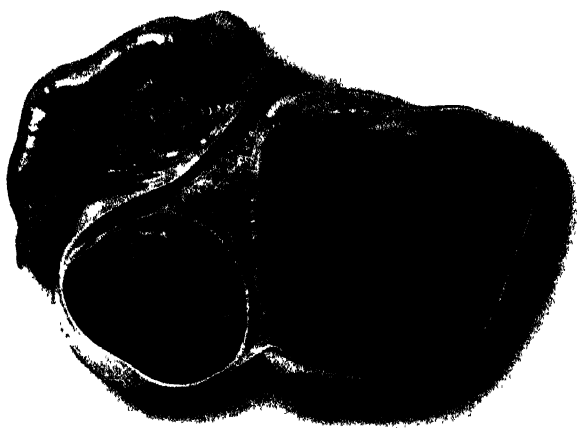
THE term ectopic pregnancy is employed here. It is more comprehensive than extrauterine or tubal pregnancy for it embraces all varieties of gestation outside the uterine cavity.

ÆTIOLOGY

It is generally accepted that fertilisation of the ovum occurs in the Fallopian tube. Consequently, it is very natural that conditions of the tube such as increased *tortuosity*, *chronic inflammation*, *obstruction* by tumours, which might conceivably interfere with the passage of the fertilised ovum into the uterus, have been advanced in explanation. Presumably, also, in some instances diverticula in the mucosa of the tube may have a similar influence. But when all is said in support of such explanations—and no doubt these conditions are the most important factors—there remains a number of cases in which no abnormality of tube being found some other explanation must be sought.

It is quite possible that the imbedding of the zygote in the tube may be influenced by such conditions as the rapidity of the cellular division of the fertilised ovum, the activity of the trophoblast, the amount of *membrana granulosa* surrounding the ovum when it escapes from the follicle and the condition of the mucous discharge in the tube, etc. It is conceivable that if, while still in the tube, the development of zygote proceeds beyond a certain point, it may imbed itself in the tube wall.

Then, if one considers the origin and development of the Fallopian tubes and uterus (p. 98), and if one recalls the arrangement of the embryos *in utero* in the lower animals, where fusion of the Müllerian ducts is less complete than in the human species, it is not surprising that ectopic pregnancy should occasionally occur. It is possible that in certain individuals the mucosa of the tubes reacts to the stimulus of the corpus luteum so that there develops there a peculiarly favourable resting-place for the zygote—this to all intents is the theory of “Decidual Reaction” as stressed by Clarence Webster many years ago. An argument in favour of some local favourable condition being the explanation in many instances are the cases recorded by a number



A



B

FIG. 108.—ECTOPIC PREGNANCY

A. Ovarian. B. Tubal.

of writers, in which there have been recurrences of a tubal pregnancy in apparently normal tubes.

Plural pregnancy has been reported many times—each tube gravid, two embryos in one and one in the other tube. Then there have been cases in which an ectopic and an ordinary uterine pregnancy coexisted.

PATHOLOGICAL ANATOMY

Although it is possible for an ectopic pregnancy to develop anywhere in the pelvic or abdominal cavity, with few exceptions it is to the interior of the tube it becomes attached in the first instance.

Ectopic implantation of a fertilised ovum may occur in the following situations, and the order in which they are mentioned is the order of their frequency (Fig. 109) : (1) ampulla ; (2) isthmus ; (3) in-

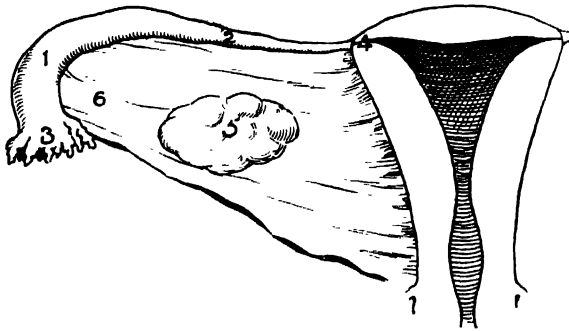


FIG. 109.—Implantation Sites in Ectopic Pregnancy in the order of their frequency.

1. Ampulla. 2. Isthmus. 3. Infundibulum. 4. Interstitial Portion of the Tube. 5. Ovary. 6. Peritoneum.

fundibulum ; (4) interstitial portion of the tube ; (5) ovary (primary ovarian pregnancy) ; (6) broad ligament, bowel, omentum, mesentery, etc. (primary abdominal pregnancy).

(1) **IMPLANTATION IN THE AMPULLA.**—This is much the commonest situation, in all probability because it is the widest part of the tube, and the ovum situated there obtains the best vascular supply.

The process of imbedding in ectopic pregnancy very closely resembles that already described for a normal uterine pregnancy. The fertilised ovum buries itself in the wall of the tube through the destructive action of the trophoblast. This occurs no matter whether the ovum becomes attached primarily to a crest or a trough of the wavy mucous membrane. All the tissues are affected—muscular connective tissue and blood-vessels. The connective-tissue cells become altered and take on to a varying extent the appearance of decidual cells. There is, however, no development of a definite decidua in the tube : this forms in the uterus. The destructive action of the trophoblast, therefore, is not limited, as in uterine pregnancy, by a decidua, so

that the thin layers of longitudinal and circular muscle fibres of the tube are broken up and destroyed. The intramural hæmorrhages natural to imbedding add to the damage done to the tube wall.

Under the microscope these changes can be readily made out—blood effusion, trophoblast, villi and irregular development of connective-tissue cells into decidual cells.

With the ovum imbedded in the ampulla several terminations are possible: (a) tubal abortion, complete or incomplete; (b) tubal rupture; (c) formation of a mole, with subsequent changes—atrophy or disintegration; (d) continuance of the pregnancy to the later months or even term.

(a) *Tubal Abortion*.—Tubal abortion is in reality an “internal”

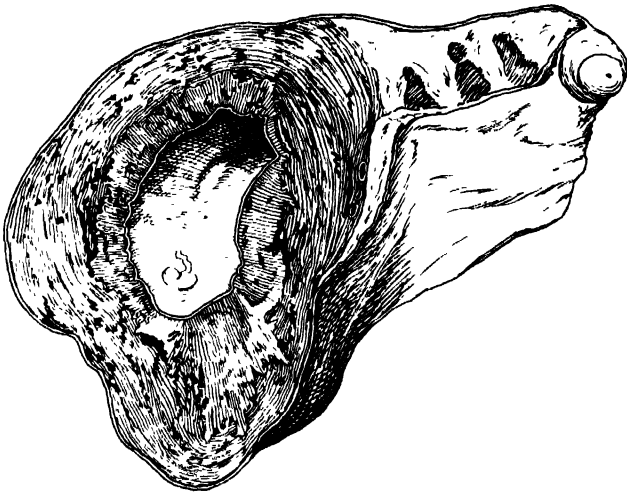


FIG. 110.—Ovum imbedded in Tube Wall.

rupture of the gestation sac, just as rupture of the tube is an “external” rupture. The ovum leaves a ragged bed in the tube wall, which is much more damaged than the uterine wall in uterine abortion. The whole or only part of the ovum may be shed, and so, as in uterine abortion, there may occur either a complete or incomplete tubal abortion (Fig. 111).

With tubal abortion there is always hæmorrhage into the peritoneal cavity. This ceases in time after the ovum is completely expelled, but often not until a considerable amount is effused. When, however, abortion is incomplete, a “drip-drop” of blood may continue from the end of the tube, and this blood, gradually accumulating, forms a pelvic hæmatocele often made up of layers of blood-clot of different ages (*vide* Pelvic Hæmatocele, p. 354).

After complete abortion the tube soon resumes its normal appearance, just as the uterus does after expelling its contents prematurely.

Everything then quietens down, and the hæmatocele disappears in time. Many cases of this nature pass unnoticed. With incomplete abortion, however, there may be recurrences of abdominal pain and vaginal hæmorrhage and other symptoms which we shall see are the characteristic features of ectopic pregnancy.

(b) *Rupture of the Tube*.—Opinions differ regarding the relative frequency of abortion and rupture, but probably the former is more frequent.

Rupture occurs most commonly between the sixth and tenth weeks, although it may occur earlier.

Rupture of the gestation sac may be sudden, a large quantity of blood being effused and the patient becoming profoundly collapsed in a very few minutes. More commonly, however, the rupture is gradual.



FIG. 111.—Tubal Abortion.

The tube wall is slowly eroded through by the trophoblast, or later by the chorionic villi.

The rupture and accompanying hæmorrhage may take place into the general peritoneal cavity (intraperitoneal rupture) or between the layers of the broad ligament (extraperitoneal rupture) for, of course, the tube is not completely surrounded by peritonæum, being uncovered along the lower part of its wall where the layers of the broad ligament come together. Intraperitoneal hæmorrhage is by far the most frequent termination, and, as might be expected, is generally the more serious, for there is no let or hindrance to the effusion of blood.

When the whole ovum is suddenly expelled into the peritoneal cavity, it usually dies; it is questionable if it can reingraft itself and develop on any peritoneal surface. Sometimes, however, where pregnancy has advanced further and rupture is gradual, the placenta remains attached in the tube, and develops there and in the surrounding tissues, while the ovum goes on growing in the free abdominal cavity—"tubo-abdominal pregnancy." For such an occurrence it is usually necessary that the foetal membranes remain intact, but it is now

known that pregnancy may continue although the membranes have ruptured.

Rupture of the tube between the layers of the broad ligament is not a common occurrence. Here, again, death of the ovum usually results, and a hæmatoma forms of varying size. Later, a *secondary rupture* into the peritoneal cavity may take place. Extraperitoneal rupture may be less grave because the layers of the broad ligament limit the hæmorrhage, although it must be remembered that they do not always do so. The effusion of blood into the broad ligament may be so great that the hæmatoma extends high up above the pelvic brim, although the gestation sac is only two months old.

In a few cases the growth of the ovum continues in the broad ligament, and the two layers become more and more separated. Many examples of extrauterine pregnancy which advance to the later months are of this nature ("extraperitoneal" or "broad ligament" gestation). In such cases the layers of the broad ligament become further separated, the peritoneum is stripped off the bladder and rectum, and pushed up by the enlarging gestation sac, which displaces all organs in its growth. These and the adhesions the sac contracts with the surrounding structures are of great protection to the sac, for it seldom ruptures into the peritoneal cavity in the later months.

(c) *Formation of a Tubal Mole.*—In this condition the ovum is surrounded by layers of blood-clot. Rupture may occur, but very often the mole shrivels up, or its tissues disintegrate and a hæmato-salpinx forms. In such cases the patient seldom continues absolutely free from abdominal discomfort; there is usually dragging pain, irregular menstruation and a general feeling of abdominal uneasiness. Should the tube become infected a pyosalpinx may form, but this is a most unusual occurrence.

(d) *Pregnancy may advance to full Term without Rupture of the Sac.*—Such cases are extremely rare. The growing sac usually contracts adhesions to the surrounding structures, and displaces them to a greater or lesser extent.

(2) *IMPLANTATION IN THE ISTHMUS OF THE TUBE.*—While theoretically the different terminations already referred to may also occur in this variety, it is found in practice that *intraperitoneal rupture is peculiarly frequent, and occurs generally at a very early date*; often, indeed, as early as the third week, before any menstrual period is missed. The explanation of this early rupture is that the muscular fibres are peculiarly scanty and poorly developed, so that the ovum readily perforates the tube wall.

(3) *IMPLANTATION IN THE INFUNDIBULUM.*—This implantation may be directly in the infundibulum, or on the elongated "ovarian fimbria." The occurrence is a rare one. The ovum either becomes detached, or, contracting adhesions to the surrounding parts, continues to develop.

(4) **IMPLANTATION IN THE INTERSTITIAL PORTION OF THE TUBE.**—In this very rare form of ectopic pregnancy the uterus is found much enlarged in one corner (Fig. 112). Subdivisions are sometimes made into ‘tubo-uterine,’ where the sac extends into the uterine cavity; and ‘utero-tubal,’ where it extends into the tube. In all probability a number of the former occur without ever being recognised, the pregnancy continuing to term, or ending as a uterine abortion—such cases are specially referred to in connection with Angular Pregnancy (p. 361).

In its typical form the developing ovum dissects up the muscular layers, hence the old term “*graviditas in substantia uteri*.” The cornu of the uterus is pushed upwards, the sac enlarging especially in that direction. Sooner or later rupture takes place, occasionally

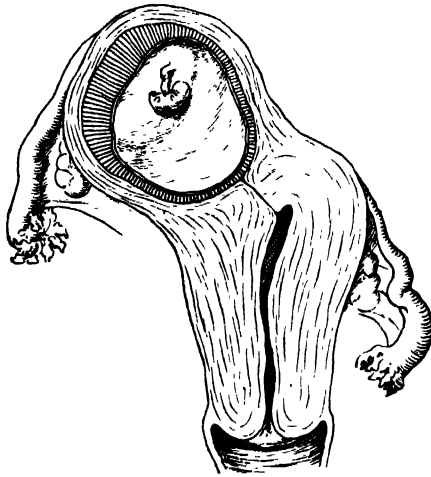


FIG. 112.—Interstitial Pregnancy.

into the uterine cavity, but most commonly into the peritoneal cavity. As might be expected, it is attended with very profuse hæmorrhage, for the large vessels at the cornu of the uterus are usually torn. It is generally stated that rupture is a late occurrence, often not taking place until the fifteenth or sixteenth week or even later; but there are many exceptions, although rupture before the tenth to twelfth week is very exceptional.

The diagnosis of this variety of ectopic pregnancy is often very difficult. It closely resembles lateral flexion of the gravid uterus (p. 291), an angular pregnancy (p. 361), pregnancy in a rudimentary horn (p. 359) or pregnancy in a uterus bicornis (p. 102).

(5) **IMPLANTATION IN THE OVARY (OVARIAN PREGNANCY).**—A considerable number of cases have been recorded—it is not so rare as was at one time supposed.

The imbedding in ovarian pregnancy follows the same course as elsewhere. The trophoblast of the ovum burrows into the stroma,

numerous hæmorrhages occur into the substance of the ovary at the site of imbedding and the stroma cells enlarge and resemble decidual cells (Fig. 113). We cannot discuss the interesting question of intra-follicular (corpus luteum) imbedding and extrafollicular (surface) imbedding.

In ovarian pregnancy rupture generally occurs at a comparatively early date. One or two cases have been recorded where the pregnancy continued to term.

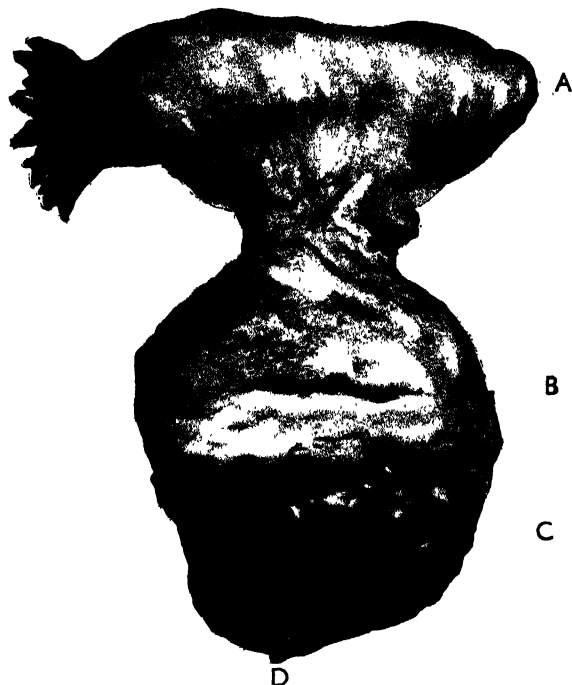


FIG. 113.—Ovarian Pregnancy.

A. Tube. B. Ovary. C. Ovum projecting from ovary. D. Rupture.

(6) PRIMARY ABDOMINAL PREGNANCY.—When one excludes the older recorded cases of so-called abdominal pregnancy, most of which were examples of *secondary* abdominal pregnancy, there are very few indeed in which one can say with certainty that the ovum was *primarily* attached to the peritoneum; especially if one admits the possibility of a tube aborting or even rupturing, and the expelled ovum reingrafting itself upon the peritoneum and continuing its development (secondary abdominal pregnancy).

Changes in Uterus and Surrounding Tissues the Result of Ectopic Pregnancy.—The uterus in ectopic pregnancy becomes altered in size, shape and consistency. At first the ectopic sac is too small to affect the position, but later the uterus may be displaced

forwards, backwards or to the side. It may also be displaced upwards, but hardly ever downwards; for even with a large sac, as in a pregnancy which advances to the later weeks, the uterus is generally dragged up, not pushed down. In size it steadily increases, sometimes as much as 1 to 2 inches (2·5 to 5 cm.). In shape it becomes more globular, and in consistency softer—these features, however, are not always pronounced.

The most striking change, however, in the uterus is the alteration of its mucous membrane into a decidua (Fig. 114), which was first



FIG. 114.—Ruptured Tubal Pregnancy, with Decidual Formation in Uterus.

(Hunterian Museum, University of Glasgow, R. R. 376, *Teacher's Catalogue*, vol. II., p. 757.)

described by William Hunter. Both macroscopically and microscopically the decidua of extrauterine pregnancy resembles the decidua which forms in the uterus in an ordinary pregnancy. A *stratum compactum* and *spongiosum* can be distinguished, the glands in the former may be observed compressed and oblique, and the epithelial cells flattened. The whole interglandular stroma is oedematous, and the typical decidual cells are everywhere evident. There is not, however, in the uterine decidua of ectopic pregnancy any trace of embryonic tissue in the form of chorionic villi.

The decidua is generally shed following tubal abortion or rupture, but it may come away unnoticed; very frequently it is not discharged until one or two days after operation (*vide* p. 350).

SYMPTOMS AND CLINICAL FEATURES

In detailing the symptoms of ectopic pregnancy our desire is to describe them in such a manner that our readers may have a clear clinical picture of this interesting condition. We have decided to continue the following grouping,¹ although a few reviewers of former editions suggested that it is rather advanced for the undergraduate.

Cases of ectopic pregnancy may be divided clinically into four groups :—

(1) The woman is struck down suddenly with abdominal pain and profound collapse—"fulminating" type (rare).

(2) The woman suffers from recurrent attacks of abdominal uneasiness, pain, occasional faintings and hæmorrhagic vaginal discharge (general type).

(3) The woman suffers from a pelvic hæmatocoele.

(4) The woman advances in her pregnancy to the later weeks (rare).

Cases belonging to Group (2) are far and away the commonest examples encountered; but the symptoms may be so slight that they are often overlooked and the case may resemble one belonging to Group (1). The cases in Group (3) always pass through Group (1) or (2), and generally also most cases of Group (4).

(1) The woman is struck down suddenly with acute abdominal pain and profound collapse

This type of acute or "fulminating" tubal rupture is very uncommon. It is seen in its most typical form when the ovum is implanted in the isthmus of the tube, although it may also occur with any implantation. If one questions the patient regarding menstruation there may or may not be the history of a period missed. It all depends upon the age of the pregnancy. There are no premonitory attacks of abdominal pain or sanguineous vaginal discharge, symptoms which, we shall see, are characteristic of Group (2), or, if present, they are so slight as to escape the patient's notice. The woman is perfectly well one minute and is suddenly seized with acute abdominal pain, the feeling of something having given way, and then collapses. The degree of collapse depends largely upon the amount of internal bleeding.

Symptoms suggest rupture of an abdominal viscus. The difficulty is to decide which organ is affected. After rupture, little may be made out on bimanual examination as the tube is soft and collapsed, and blood poured into the abdominal cavity takes some time to make itself distinctly felt as an effusion in the pouch of Douglas (pelvic hæmatocoele, p. 354); the sensation there is one of fullness. Further, an exact diagnosis is specially difficult in this type of fulminating

¹ Originally appeared in *Operative Midwifery*, by Munro Kerr, 1st Edition, 1908.

rupture, because the rupture, as we have seen, very frequently occurs early in pregnancy before any menstrual period has been missed. Rigidity of the abdominal wall is almost entirely absent, because blood effused causes little irritation to the peritoneum. This absence of rigidity in the right iliac fossa is an important feature in differentiating the condition from appendicitis. The outstanding feature is progressive evidence of internal bleeding (anæmia, rapid pulse, etc.).

The conditions which simulate "acute" or "fulminating" tubal rupture are: (a) a fulminating appendicitis; (b) rupture of a gastric or duodenal ulcer; (c) torsion of a pedunculated tumour, most generally of the ovary. In none of them, however, is the collapse so profound or so rapid.

With a fulminating appendicitis there is always tenderness and rigidity over the region of the appendix. In the case of a perforating gastric or duodenal ulcer there may be a history of old-standing digestive disturbance, and palpation over that region causes tenderness and rigidity. Confusion arises occasionally from the fact that in perforated gastric and especially duodenal ulcer, pain is sometimes referred to the right iliac region. In torsion of the pedicle of an ovarian cyst (p. 1022) the resemblance becomes marked if, in addition to the severe pain complained of, there is a slight uterine hæmorrhage—a not uncommon occurrence with a twisted pedicle. Should the patient be seen shortly after the attack of pain and collapse so characteristic of torsion, the diagnosis is easy, for a distinct and very tender tumour is felt bimanually in the case of an ovarian tumour, while no tumour is felt in the case of ruptured ectopic pregnancy.

(2) *The woman suffers for some time from abdominal uneasiness, pain, hæmorrhagic vaginal discharge and occasional faintings*

This type is much the most common. It is of the greatest importance to remember that the subjects of ectopic pregnancy are not as a rule struck down suddenly without warning, but that there are premonitory symptoms or warnings generally of so marked a character as to necessitate medical advice. This is not fully appreciated. We have generally found in questioning students that their mental picture of ectopic pregnancy is a woman suddenly prostrated by internal hæmorrhage. But before the symptoms characteristic of this grave condition appear there are *warning signals*; and, as in so many other diseases, we must ever try to recognise these early signals.

In no disease is a careful consideration of the history more important. This can be best illustrated by detailing briefly a specific example:—

Patient aged twenty-eight has had three children. Menstruation and labours have been normal. Last period occurred on February 23. About April 12 she began to have abdominal pain and uneasiness, and this continued

less or more until May 3, when pain became suddenly extremely severe, and the patient collapsed. There was no vaginal hæmorrhagic discharge until day of collapse. She was admitted to hospital on May 5, when she stated that all abdominal pain had gone. Upon examination a swelling about the size of an orange was found behind and to the right of the uterus. When the abdomen was opened it was found that the tube had completely expelled its contents, and that the whole ovum was lying in the peritoneal cavity amongst a considerable collection of blood. The blood-clot and ovum were removed, but as there was no bleeding from the tube both it and the ovary were conserved.¹ This case is an example of complete tubal abortion. It is noteworthy that the pain entirely disappeared following on the extrusion of the ovum from the tube.

The history is always similar—recurrent attacks of abdominal pain and uneasiness, hæmorrhagic vaginal discharge and feelings of faintness, and very frequently, although not always, a period of amenorrhœa. But while the picture is so characteristic when put down in writing, it is often a little difficult at the patient's bedside to appreciate fully the significance and gravity of the symptoms prior to collapse—viz., at an early stage. The vaginal hæmorrhage is apt to be attributed to a delayed menstrual period, or threatened abortion, and the pain, if slight, to intestinal colic; while faintness and sickness, not being peculiar to ectopic pregnancy, are considered as the ordinary discomforts of a uterine gestation.

Let us consider these symptoms *seriatim*, and firstly *abdominal pain and uneasiness*. There is very frequently a dull, constant, aching pain caused by the intramural hæmorrhages already described. But the acute attacks of pain occurring at varying intervals, so characteristic of the condition, are due to a colic in the tube and uterus. Later, if the sac goes on growing and the muscular fibres are destroyed, these colicky pains disappear, for spasmodic contraction of the tube is then impossible. So also may they disappear after abortion or rupture, as the case described above illustrates. If blood has been effused into the peritoneal cavity, a more or less constant ache may be complained of, due to irritation of the peritoneum. Scapular or interscapular pain may also be complained of. It is entirely a matter of accident how frequent these attacks of pain are, or how many occur before tubal rupture or abortion. Entire absence of pain is very rare indeed, although in a number of cases the pain is slight and can only be described as an uneasiness.

The importance of abdominal pain cannot be too strongly emphasised; it is always a symptom which should arrest attention. In the case of ectopic pregnancy it is usually situated low down in the abdomen, and very often is more marked on one side, although it may extend over the whole lower quadrant. There may also be rigidity more marked on the affected side, but not so pronounced as with appendicitis, because, as already mentioned, aseptic blood does not irritate the peritoneum as do the infectious contents of an appendix. Pressure

¹ This is seldom possible as the tube wall is generally much torn and otherwise injured (p. 340).

does not relieve this pain as it does an intestinal colic. Another point of difference between tubal and intestinal colic is that with tubal pregnancy abdominal uneasiness continues after the acute pain has passed, whereas with intestinal colic the woman feels perfectly well whenever the spasm passes off.

Amenorrhœa is usually present, although occasionally abdominal pain and uneasiness come on before there is time for a menstrual period to be missed. If tubal pregnancy occurs during lactation, or if there is some pathological condition associated with amenorrhœa, such as anæmia or chlorosis, the diagnosis may be more difficult. The number of periods missed varies. In only a few is the abdominal pain delayed until after the second missed period. Naturally, amenorrhœa is a symptom of very great importance, for it at once directs attention to pregnancy, and in association with abdominal pain to some complication of pregnancy.

It sometimes happens that the next symptom, *hæmorrhagic vaginal discharge*, may lead to confusion and may be mistaken for a menstrual period, particularly if the discharge comes on at or about the time a menstrual period is expected, or would have occurred, had pregnancy not existed. If, however, this symptom is inquired into, it will be found that, in somewhere about 70 per cent. of cases, the hæmorrhagic discharge has been preceded by abdominal pain and discomfort. Furthermore, it is irregular in its time of appearance and it is seldom abundant.

In many cases the discharge is attributed to a threatened abortion, especially if one or two periods have been missed. The differential diagnosis between these conditions is considered later.

The fourth feature of cases belonging to this group is occasional *feelings of faintness, nausea and sickness*, amounting sometimes even to syncope. These symptoms are due to irritation of the peritoneum, to the intramural hæmorrhages which tensely distend the sac wall, and to tubal colic. The faintness may be due to internal hæmorrhage if the hæmorrhage is abundant; but in many cases where there has been a distinct syncope, internal bleeding is found at operation to be slight, and, *per se*, could not have produced the collapse. Besides, the patients get over the syncopal attacks very quickly, unless the internal hæmorrhage is profuse and the case has really passed into Group (3) with the formation of a pelvic hæmatocele.

In referring to the hæmorrhagic discharge we purposely did not mention the *expulsion of a uterine decidua*, because we did not wish to give the impression that this was a symptom which should be counted on. Undoubtedly, when present, it is a feature of great value; but it is very generally a late sign, frequently not appearing until there have been several attacks of pain and the tube has aborted or ruptured. Very often the cast is not shed until after operation. Taking a series of cases reported by different operators, a decidual cast is noted in not

more than 30 per cent. of cases. Without doubt the decidua is often lost in the discharge, especially at such times as the bowels and bladder are evacuated.

The presence of the *ordinary subjective symptoms of pregnancy*, such as morning sickness, pain in the breasts, and other mammary changes, cannot be relied upon in ectopic pregnancy in the early months, and this is why they are placed far down the list of symptoms. Naturally, if present, they confirm the diagnosis of pregnancy; but they are very often less pronounced in extrauterine than in intrauterine gestation.

Irritation of the bladder, amounting frequently to dysuria, is a common symptom, especially if there is a large sac or collection of blood in the pouch of Douglas pushing the cervix forward against the bladder. This is referred to in connection with pelvic hæmatocele (p. 354). Constipation is very frequent, but this is so general with women, especially during pregnancy, that it is of no value from a diagnostic point of view. *Rectal tenesmus* is on quite a different footing. It will be fully considered in connection with pelvic hæmatocele, of which condition it is an important symptom (p. 355).

BIMANUAL EXAMINATION.—In carrying out this examination in a case of suspected ectopic pregnancy, great care must be exercised—a gravid sac very readily gives way if roughly handled. *Especial care must be taken when examination is made under an anæsthetic*, for, the patient being unconscious, there is nothing to warn the examiner of the danger from pressing too firmly.

The sac of an ectopic pregnancy varies greatly as regards size, consistency and position. Its size depends upon the age of the pregnancy, but also not a little upon the amount of intramural hæmorrhage which has occurred. Besides, sooner or later the sac contracts adhesions to the surrounding intestines, ovary, broad ligament, etc., and there is thus formed a mass of *indefinite* outline. The consistency, too, is not constant. Theoretically it is soft and elastic, but, as a matter of fact, especially after any effusion of blood into the wall of the tube, it may feel just as firm as a solid tumour. Pulsation in the vaginal fornix over its surface is a feature of some diagnostic importance; but in inflammatory conditions of the tubes (salpingitis) pulsation is also well marked. Even in early uterine pregnancy it may be noted if the body of the uterus is pressed down from above. But there is one feature of great importance: *the sac is generally very tender to the touch*. This is a most significant sign. The reasons for the extreme pain are overdistension of the tube and the intramural hæmorrhages.

The sac in the early weeks is commonly situated to one side and rather behind the uterus; as it increases it very generally extends farther backwards and downwards. In so doing it pushes the uterus forwards and upwards. *Very seldom is the sac found in front of the uterus;*

although after intraperitoneal hæmorrhage some blood may collect in the utero-vesical pouch. When rupture occurs into the broad ligament the swelling is distinctly lateral and the uterus markedly pushed over towards the opposite side.

The sac is most difficult to define by palpation in cases in which the uterus is backwardly displaced, or the sac is situated far out in the ampulla and is closely surrounded by the intestines. In all doubtful cases the patient should be examined under anæsthesia. As already mentioned, the very greatest caution must be exercised in making this examination. Sometimes in this as in many other pelvic conditions (p. 114), a bimanual rectal examination is most helpful in determining the nature of the swelling.

DIFFERENTIAL DIAGNOSIS.—It occasionally happens, in spite of the fact that the clinical history is generally so typical and the physical signs so characteristic, that the diagnosis is not as simple in practice, and that other conditions may simulate ectopic pregnancy. Most important of these are intestinal colic, uterine abortion and retroflexion of the gravid uterus. But salpingitis, appendicitis, and tumours of the ovary and uterus, especially when associated with intrauterine abortion, may resemble very closely ectopic pregnancy—so closely that the differential diagnosis is sometimes extremely difficult.

Uterine Pregnancy with Intestinal Colic.—This particular condition has been already considered (p. 349).

Intrauterine Abortion.—The most common mistake is to diagnose uterine abortion when what really exists is an extrauterine pregnancy.

Very frequently this mistake is made; indeed, in a considerable number of cases which come under the specialist's care the doctor in attendance has imagined he was dealing with an incomplete abortion. Consequently in all cases of abortion the possibility of extrauterine pregnancy should be excluded. This can be done by asking oneself the following questions: (1) Is the woman pregnant? (2) Is the pregnancy uterine or extrauterine? (3) If uterine, is the abortion threatened, complete or incomplete?

We have great sympathy for the family practitioner who overlooks an extrauterine pregnancy and mistakes the condition for a threatened uterine abortion; he sees relatively few examples of the former, while daily he may encounter the latter condition. In many cases it is necessary to anæsthetise the patient before a satisfactory bimanual examination is possible, and this should be done if there is the slightest suspicion of extrauterine pregnancy.

The other mistake of considering the condition extrauterine when it is really an intrauterine pregnancy is also occasionally made and most commonly where there is a lateral flexion of the uterus.

Lateral Flexion.—This is often associated with a considerable amount of abdominal pain and discomfort. The mistake is specially

liable to be made about the twelfth week of pregnancy, when the mobility of the body of the uterus is most pronounced. The displacement, very often due to an implantation of the ovum in one or other of the upper angles of the uterus at the entrance of the Fallopian tubes, is known as "Angular Pregnancy" (p. 361). In some instances it is in reality an interstitial pregnancy (p. 344) in which the ovum develops towards the uterine cavity.

Retrodisplacement of Gravid Uterus.—Another displacement which may very closely resemble ectopic pregnancy—viz., retrodisplacement of the gravid uterus—has been already considered and the differential diagnosis described (p. 289).

In differentiating the two conditions, most careful consideration of the anamnesis is essential. With ectopic pregnancy symptoms generally develop early; with retroflexion of the gravid uterus, on the other hand, the symptoms develop later and the first symptom is dysuria. The physical examination in ectopic pregnancy reveals a swelling distinct from the uterus and very tender; in retroflexion of the gravid uterus the enlarged fundus in the pouch of Douglas is continuous with the cervix and is not tender.

Salpingitis.—As we shall see later, salpingitis is generally bilateral (p. 1034) and there is a history of old-standing pelvic inflammation. Should, however, the salpingitis be limited to one side, the swelling connected with it may resemble an ectopic sac. Salpingitis causes generally excessive periods and is never associated with amenorrhœa, so there is no history of a missed period. The Aschheim-Zondek test may be most helpful in reaching a correct diagnosis.¹

Appendicitis.—Occasionally a right-sided ectopic pregnancy may very closely resemble appendicitis, and, as a matter of fact, this mistake is not infrequent. The most difficult cases are where appendicitis complicates an intrauterine pregnancy. In coming to a decision one must be influenced by the history, local rigidity and presence or absence of a swelling.

Ovarian Tumour.—The differential diagnosis between a small ovarian cyst and an ectopic pregnancy is seldom difficult, except under two conditions: (a) torsion of the ovarian cyst; (b) a coexisting uterine abortion. The symptoms of torsion of the pedicle of an ovarian cyst are described elsewhere (p. 1022). In the other condition, where the ovarian tumour is complicated by an intrauterine abortion, it is sometimes impossible to tell the one condition from the other, except on the ground that an ovarian cyst is well defined and insensitive, while an ectopic sac is less well defined and exquisitely tender.

Fibromyoma.—The differential diagnosis between ectopic pregnancy and a fibromyoma is almost always easy, as a fibromyoma is a hard swelling incorporated in the uterus. A mistake may be made if the

¹ There is a possible fallacy here. If a tubal mole exists and all the chorionic villi are dead the Aschheim-Zondek test will be negative.

tumour is soft from degeneration (p. 940), and especially if there is a coexisting intrauterine abortion.

(3) *The woman suffers from a pelvic hæmatocele*

When recovery occurs from free peritoneal hæmorrhage a "pelvic hæmatocele" forms, but it takes time for the blood to gravitate into the pouch of Douglas. Generally speaking, only relatively small pelvic hæmatoceles are now encountered, for the condition of ectopic pregnancy is better understood and abdominal section is seldom delayed. But thirty or forty years ago gynæcologists frequently encountered large effusions, not only filling the pouch of Douglas but extending round the uterus into the utero-vesical pouch and up above the pelvic brim (Fig. 115). In these days the patient was admitted to hospital



FIG. 115.—Pelvic Hæmatocele.

profoundly blanched and collapsed, with a subnormal temperature and rapid, thready pulse. Often she lay in the wards unoperated upon, the effused blood being allowed to absorb; there was frequently a slightly febrile temperature after the first few days and the patient's complexion became yellow as a result of this slow absorption. But we can dismiss such cases, as they are rarely seen nowadays, and go on to consider the relatively small pelvic hæmatocele, which is still quite commonly encountered.

On making a vaginal examination shortly after rupture or tubal abortion probably nothing is felt, as the effused blood is free in the peritoneal cavity. Later, an elastic effusion in the pouch of Douglas,

and still later, when the blood coagulates, a semi-solid swelling, can be made out. *It gives a peculiar and characteristic sensation to the examining fingers*; in some parts it feels hard and in others soft. Further, its limits cannot be defined, for it spreads across the pelvis. Occasionally, therefore, on bimanual examination, it simulates a pelvic cellulitis and peritonitis. But the history of the two conditions is so different that they can only be confused if, as sometimes happens, the hæmatocele becomes infected—a complication we shall refer to in a moment.

The effusion displaces the uterus a little to the side, and most commonly forwards and upwards against the bladder. Occasionally if the blood collects in the utero-vesical pouch, the uterus is found imbedded in the effusion or actually pushed back into a position of retroversion.

As a rule a pelvic hæmatocele is not associated with actual pain, but there is a feeling of abdominal and pelvic discomfort. After the collapse is recovered from, the pulse improves; but the temperature, which was subnormal, may rise slightly above the normal in the course of a few days, although this is not so common as in the large hæmatoceles encountered in former years and already described.

As the effusion very generally presses the cervix forward against the bladder, slight and occasionally pronounced *dysuria* is complained of. This may throw the unwary off his guard and lead him to suspect that he has to deal with an incarcerated retroflexed gravid uterus—the differential diagnosis of these conditions has been referred to already (p. 289). Less frequent, and as a result of pressure on the rectum behind, the patient may complain of *rectal tenesmus*. This symptom is rarely observed unless there is a distinct pelvic hæmatocele—it is of great significance when present.

Should the pelvic hæmatocele be seen later, when a considerable portion of blood is absorbed, the swelling remaining may simulate an ovarian cyst or salpingo-oöphoritis, but the history of the case will usually clear up matters.

The most serious complication of pelvic hæmatocele is infection. Fortunately it is relatively infrequent, and, being localised, is seldom so grave as one might expect. If of some weeks' standing, it may render the differential diagnosis between ectopic pregnancy and salpingitis very difficult; indeed, in a number of such cases the true nature of the condition is only revealed after the abdomen is opened.

(4) *Cases in which ectopic pregnancy advances to the later months*

Cases of this type are not very common. With them, as with those of the previous groups, the history is of the greatest importance. For example, one very generally finds, on questioning the patient, that she has passed through Group (2); early in the pregnancy she has had attacks of pain, faintness, etc. In some cases such discomforts are

slight, and may have been forgotten by the patient; but only very occasionally have they been entirely absent.

As pregnancy progresses and the disturbances referred to pass off, the patient may experience certain discomforts which induce her to seek medical advice. The discomforts are seldom pronounced and the symptoms are often so vague that the medical attendant attributes them to the ordinary disturbances so frequently associated with pregnancy in the later months. Even the situation of the sac becomes very much that of the gravid uterus. Abdominal distension is usually more marked on one side than the other, but one sees this in normal pregnancy. There is this difference, however: the gravid uterus can be pulled over to the middle line, while a large gravid ectopic sac is generally fixed.

Theoretically, the ease with which the foetal parts can be palpated in advanced ectopic pregnancy should be of assistance, but we see many cases of intrauterine gestation in which this is just as striking. In many cases, therefore, the diagnosis of an extrauterine pregnancy in the later months is not easy.

On vaginal examination it will be found that the cervix is not so soft and is often displaced slightly. But very frequently the ectopic sac is so closely applied to the uterus that it is difficult to distinguish the one from the other. Radiography has proved useful in the differential diagnosis of this from other pelvic conditions.

In the relatively rare cases in which ectopic pregnancy advances to term, phenomena occur which are referred to as "spurious labour." There is severe abdominal pain, slight dilatation of the cervix, and often expulsion of the uterine decidua, with a hæmorrhagic vaginal discharge. The foetus, if alive, gives evidence of distress, its movements being extremely active; later they quieten down and cease altogether. Rupture of the sac very seldom occurs at this stage, because it is well supported by the adhesions it has contracted to the surrounding structures.

After the death of the foetus a variety of changes may occur in the sac and its contents. The liquor amnii is absorbed and the sac shrinks, so that the abdominal tumour gradually diminishes in size. Such shrunken sacs are often retained for years and may be only accidentally discovered during an abdominal operation or at a post-mortem examination. The foetus may become altered in different ways. Most commonly it becomes *mummified*, when the foetus, membranes and placenta become shrivelled up. An *adipocerosus* transformation is also described when the tissues of the foetus become altered into this soapy-like yellow substance. *Calcification* is yet another change. This rarely amounts to more than a deposit of lime in the membranes and placenta, and a scattered deposit in the foetus. Occasionally, however, the true *lithopædion* results, the superficial and sometimes the deeper tissues of the foetus becoming

impregnated with lime salts. This condition shows up well in a radiograph.

Should the sac become infected, and occasionally without infection, the disintegrated contents may find an outlet through bowel, vagina, abdominal wall, or even bladder. This termination is very rarely observed nowadays, but fifty years ago it was not uncommon.

TREATMENT

The simplest arrangement is to discuss the treatment of each of the groups just described. The actual operative details are considered in the gynæcological section of the work (Chapter LIX).

(1) **THE WOMAN IS STRUCK DOWN SUDDENLY WITH ABDOMINAL PAIN AND PROFOUND COLLAPSE.**—In such cases the all-important question is: Should one operate no matter how collapsed the patient is; or should one give the patient time to recover from the profound shock? *The safer procedure is immediate operation in all cases.* If the patient is extremely collapsed, the immediate operation adds very little to the shock already present, for the operation can be carried through in a few minutes and with light general or local anæsthesia. The operation consists in removing the sac and all blood-clot. *She should be given a blood transfusion* (p. 564). In the event of there being no suitable donor the patient's own blood may be used in this type of case. To 1 pint of blood collected add 5·5 c.c. of a 2·5 per cent. solution of sodium citrate—the mixture at the body temperature should be filtered through sterilised gauze and run into one of the larger veins. If it is impossible to obtain whole blood or serum, 1 or 2 pints of normal saline solution underneath the breast or into a vein and into the abdominal cavity before it is closed may be given, but it is a poor substitute. The patient is then put back to bed and the foot of the bed raised. If deemed advisable, she is given some brandy by the rectum, but we would strongly caution against the danger of overstimulation, a mistake which is very often made.

(2) **THE WOMAN SUFFERS FOR SOME TIME FROM ABDOMINAL UNEASINESS AND HÆMORRHAGIC VAGINAL DISCHARGE.**—In this group immediate operation is always advisable.

The operative procedures are very simple. Usually there are slight adhesions between the tube and surrounding structure, but these are readily broken down, and the sac, be it an aborting tube or a ruptured tube, is removed (Gynæcological Operations, Chapter LIX). Should the rupture have occurred into the broad ligament and a large hæmatoma exist, the broad ligament should be split open, all blood-clot removed, and the cavity packed with gauze. The broad ligament is then stitched over and the end of the gauze brought out through a counter-opening in the vagina. It is undesirable, if it can be avoided, to bring out the gauze through the abdominal wound, for drainage in this direction is unsatisfactory and the abdominal wound is weakened.

A conservative treatment of the tubes in cases of tubal pregnancy has been suggested in recent years by several operators. Some, for example, have dilated the abdominal end of the tube and pressed out the ovum; others have split open the tube and shelled out the ovum from its wall. In the latter case the wound in the tubal wall is carefully sutured. We have tried this treatment on several occasions, sometimes with success. In the majority of cases, however, the oozing of blood is so continuous and difficult to control that one is afraid to leave the tube behind. It must be remembered that, although the distended tube gradually returns to the normal, it has not the retractile and contractile properties of the puerperal uterus.

(3) **PATIENT SUFFERS FROM A PELVIC HÆMATOCELE.**—All gynæcological surgeons are in favour of operation and opposed to expectant treatment as practised in former times.

If operation is decided upon, either the vaginal or abdominal route may be chosen, and there is much to be said for both. By the abdominal route all blood-clot can be cleared away, and any other unsatisfactory state of tubes, ovaries, or uterus may be corrected. The disadvantage of this route is that the hæmatocele, shut off by adhesions between the intestines, is opened into through the general abdominal cavity, whereas by opening through the vaginal vault the collection of blood can be easily reached and blood-clot removed without opening into the general peritoneal cavity.

The abdominal route should be chosen under ordinary circumstances. But for an infected pelvic hæmatocele, the vaginal route is safer, as with an incision through the posterior fornix of the vagina excellent drainage is established (p. 1069).

(4) **ECTOPIC PREGNANCY IN THE LATER MONTHS.**—Before describing details regarding the operative treatment of such cases, one must consider the question as to whether it is ever advisable to delay operating for the sake of the child. Now, it is never advisable to delay operation in cases of ectopic pregnancy recognised in the early weeks, because tubal abortion or rupture is almost sure to occur. But in the later weeks rupture very rarely happens; consequently, delay is permissible, provided the patient is placed under such conditions that immediate operation can be performed should this become necessary. There are many cases now on record in which a living healthy child has been secured. If the fœtus is dead, delay, of course, is purposeless.

The chief difficulty in operating upon cases of advanced extra-uterine pregnancy is the *treatment of the placenta*. There is never any difficulty in opening into the sac or in removing the fœtus, but there may be considerable difficulty in dealing with the sac, and especially with the placenta. The ideal treatment is to remove the sac entire—fœtus, placenta and membranes. This is generally simple if the child has been dead for some time, as a “dead” placenta is easily stripped off, and any little bleeding that occurs can be readily controlled. But

the site of a "living" placenta may bleed very freely when the latter is separated, because the site, being usually on cellular tissue, is non-contractile. Besides, in the process of separation, if the placenta is attached to the mesentery, serious injury may be done to the blood supply of a portion of the intestines. In recent years the successes attending immediate removal of the "living" placenta have been increasing in number. Occasionally the arterial blood supply may be cut off by ligating the ovarian and uterine vessels before proceeding to separation. In other cases, separation of the sac by degrees and carefully "under stitching" bleeding points has proved successful. Sometimes the hæmorrhage from the raw placental site has been so great as to necessitate compressing the aorta until the bleeding was controlled. Recourse has been had to gauze packing in some desperate cases, but rarely is this effective unless the placenta site is situated in the pelvis and the gauze can be jammed against the pelvic wall. One end of the gauze should be brought out into the vagina if possible.

Closing the abdominal wound and leaving the placenta to take care of itself has proved satisfactory and is a good alternative if the operator anticipates severe bleeding from detaching the placenta. The cord should be tied close to the placenta. The sac should not be drained; but any portions of the sac wall which can be easily detached should be removed.

PREGNANCY IN A RUDIMENTARY HORN

This malformation and some of the disturbances it may produce have been referred to elsewhere (p. 102). Here, however, we must discuss the gravid rudimentary horn, because clinically it resembles ectopic pregnancy in many details. As the illustration (Fig. 116) indicates, the connection between the two horns is by a fibromuscular band of from 2 to 5 cm. This band is usually attached to the normal horn about the level of the internal os, although its lower margin may be as low as the os externum. In the great majority of cases no canal is present, and generally if it exists it is incomplete. As there is so seldom a canal, impregnation must occur by the spermatozoa passing through the normal half of the uterus and tube, and impregnating an ovum which has been shed from the ovary connected with the rudimentary horn. In some few cases, however, the ovum has come from the other ovary, as the corpus luteum has been observed in the ovary connected with the normal horn. The fertilised ovum then passes into the rudimentary horn and develops there.

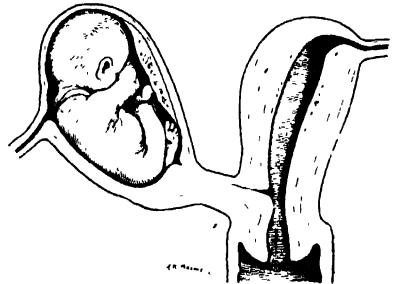


FIG. 116.—Pregnancy in a Rudimentary Horn. Note stalk of Horn is not canalised.

The course of pregnancy in a rudimentary horn varies. In a large proportion of cases rupture occurs because of the poorly developed musculature. The fourth or fifth month is the most usual time for this occurrence, but in a number of cases it takes place earlier, and in a few even later. Cases have been recorded in which the pregnancy had advanced to term. The time of rupture depends largely on the state of development of the rudimentary horn.

In the cases in which rupture occurs it will be found that the clinical features sometimes resemble those found in ectopic pregnancy (described under Group (2))—recurrent attacks of abdominal pain, tenderness, faintings, vaginal discharge, and expulsion of a decidua from the normal uterine horn. In others the rupture and collapse occur suddenly without any premonitory symptoms, such cases being comparable to those belonging to Group (1) (Fig. 117).

Where the pregnancy continues to term, a spurious labour occurs and the foetus dies. A foetus retained after its death may undergo all the changes already described in connection with extrauterine pregnancy which has advanced to the later months.

It is comparatively seldom that a gravid rudimentary horn is diagnosed before the abdomen is opened. Tubal pregnancy is the usual diagnosis. But in a few cases it has been recognised before operation. The relative position of the two round ligaments and the separation of the tumour from the uterus are important features, especially in the early months: but as pregnancy advances the sac becomes so large that these landmarks are difficult to distinguish. Later in pregnancy, when the gravid horn is of large size, the latter may be mistaken for the normal uterus and the non-gravid normal horn for a myoma or an ovarian tumour.



FIG. 117.—Rupture of a Gravid Rudimentary Horn.

Of the rare complications which are associated with a gravid rudimentary horn mention may be made of torsion, and prolapse into the pouch of Douglas. These rare occurrences lead to very complicated conditions often difficult to diagnose and unravel until the abdomen is opened.

The treatment is to remove the gravid horn and leave the normal half. In a number of cases normal pregnancy and labour have followed at a later date in the horn left—*e.g.* in the case here illustrated (Fig. 117). In most cases the removal of the gravid horn is not difficult. The ovarian vessels are ligated in the infundibulopelvic ligament, and then the band connecting the horn with the other half of the uterus is secured.

Special care must be taken in ligating the latter, for there may be very free bleeding if it is not carefully tied. Sometimes adhesions to the surrounding structures exist, so that considerable difficulty may be experienced in separating them and in securing all the bleeding points.

It may occasionally happen that the association of the sac and the other horn of the uterus is so intimate that hysterectomy of both horns is deemed advisable.

ANGULAR PREGNANCY

The writer would stress the fact that angular pregnancy is a definite clinical entity and a most interesting condition.

Angular pregnancy is that particular variety in which the zygote becomes implanted in the angle or cornu of the uterus. The exact implantation site would appear to be either directly over the tubal opening or just external to that opening in the commencement of the interstitial portion of the tube. The condition is quite distinct from the typical interstitial variety of ectopic pregnancy (p. 344), for the ovum develops not *in substantia uteri* but towards the uterine cavity. The term "angular" (Fr. *angulaire*, Gr. *tubenecken*) has been applied in order to distinguish it from "interstitial" pregnancy on the one hand and "cornual" pregnancy on the other hand, as the latter term is very generally used to describe a pregnancy in the horn of a uterus bicornis (p. 102).

The clinical features of this condition are (1) severe pain, (2) lateral distension of the uterus on the affected side, (3) tendency to abortion. In a number of cases the placenta is retained and difficult to remove, as it is held up in the sacculum at the uterine angle.

PREGNANCY IN A UTERINE DIVERTICULUM

The origins of uterine diverticula have been referred to already (p. 103). Such diverticula are very rare, and pregnancy in one still more so. The latter condition may closely resemble pregnancy in the interstitial portion of the tube (p. 344), or Angular Pregnancy (referred to above). Some anomalous examples of rupture of the uterus during pregnancy are probably due to imbedding of the ovum in a diverticulum.

PART IV
NORMAL LABOUR



Upper Contractile Wall.

Cervix and Lower Uterine Segment.

External Os.

Vagina.

FIG. 118.—Illustrating the Wall of the Parturient Canal in the Second Stage of Labour. The subject died suddenly. A complete length of the wall was pinned to a board to prevent shrinkage during preservation. This portion was used for teaching purposes.

CHAPTER XVIII

THE FACTORS OF LABOUR

The Passenger—The Passage—The Powers

THE factors concerned in labour are: (I) The Passenger—the foetus—placenta and membranes. (II) The Passage. (III) The Powers or Forces—the uterine contractions, and the auxiliary forces that aid in the expulsion of the child.

1. THE PASSENGER—THE FŒTUS

The full-time foetus measures 20 inches (50 cm.) in length, but in the uterus it lies with its legs, arms and head flexed. The term applied to the relative position of the foetal parts to one another is the *attitude*. The normal attitude of the foetus *in utero* is therefore one of universal flexion. In this attitude the length of the full-time foetus is 10 inches (25 cm.).

The body of the child is very compressible and the limbs readily undergo any slight displacement required to render the delivery of the body easier. The body itself can bend freely in almost any direction demanded for its easier descent during labour.

The Foetal Skull.—In the great majority of cases (96 per cent.) the child is born head first, and, as it is the most difficult part to deliver under ordinary conditions, it follows that when the head is free of the maternal passage the rest of the birth is easy. For these reasons a careful study of the foetal skull is necessary as an introduction to the consideration of labour.

From an obstetrical point of view the head may be divided into the base, the face, and the vault. The base is composed of bones which at birth are firmly joined together. It is the most incompressible part, and its solidity protects the medulla against the shearing strains to which the vertex is subjected during labour. The facial bones also are firmly united at birth, and any change which occurs in this part of the head affects the soft tissues only. Certain terms are applied to particular areas of the foetal head. (a) *Sinciput*, the area from the anterior fontanelle to the root of the nose; (b) *Vertex*, area from the anterior fontanelle to the posterior fontanelle; (c) *Occiput*, area from the posterior fontanelle to the foramen magnum (Fig. 119).

The bones comprising the vault are at birth incompletely ossified, and although their central parts are ossified, their edges are

membranous and are separated from one another by the bridging *sutures* of soft tissue. This fact is of great importance in labour, for it allows of a considerable overlapping of the bones and a corresponding diminution of the size of the head—this process is called *moulding* of the foetal head. The interior bulk of the head is diminished under these circumstances by the fact that the pressure on the outside drives a certain amount of the cerebro-spinal fluid and blood from the cranial cavity to other parts of the body. Moulding is a factor of great importance in labour, as it renders easier the passage of the head through the maternal canal. In the most common mode of delivery the moulding is such that the occipital and frontal bones are driven under the parietals and one of the parietals is driven under the other, depending upon the position of the head.

Bones forming the Vault.—These are the two parietals and the upper parts of the frontal, temporal and occipital bones. At birth the frontal bone is divided into lateral halves.

Sutures.—These are : (1) *Frontal*—between the halves of the frontal bone. (2) *Sagittal*—between the two parietal bones. (3) *Coronal*—between the frontal and parietal bones. (4) *Lambdoidal*—between the occipital and parietal bones. (5) *Temporal*—between the temporal and parietal bones.

Fontanelles.—These are the spaces formed between the angles of the bones at the point of junction of the various sutures. The *anterior fontanelle* or *bregma* is at the junction of the frontal, sagittal and coronal sutures. It is a comparatively large lozenge-shaped space, the anterior angle being long and acute. It has four sutures running into it. These characteristics make it easy of recognition during labour. The *posterior fontanelle* is at the junction of the sagittal and lambdoidal sutures. It is small (during labour it is usually obliterated) and it has three sutures entering it (Fig. 119). There are two *lateral fontanelles* on each side, the anterior and the posterior, lying respectively at the ends of the coronal and lambdoidal sutures.

The anterior fontanelle or bregma and the posterior fontanelle are of great importance, for their recognition during labour by the examining finger provides an index of the position of the head in the maternal passages. The lateral fontanelles have no obstetrical importance.

Diameters of the Foetal Skull.—The measurements of the following cranial diameters are of importance (Fig. 119) :—

1. *Occipito-mental*—from the posterior fontanelle to the tip of the chin. $5\frac{1}{4}$ inches (13 cm.).
2. *Occipito-frontal*—from the root of the nose (glabella) to the posterior fontanelle. $4\frac{1}{2}$ inches (11.2 cm.).
3. *Biparietal*—between the parietal eminences. $3\frac{1}{2}$ inches (8.7 cm.).
4. *Fronto-mental*—from the chin to the level of the frontal eminences. $3\frac{1}{2}$ inches (8.7 cm.).

5. *Suboccipito-bregmatic*—from the centre of the anterior fontanelle to midway between the occipital protuberance and the foramen magnum. $3\frac{3}{4}$ inches (9.3 cm.).

(CIRCUMFERENCES.—The circumferences are approximately three times the length of the corresponding diameters :—

1. *Occipito-mental*—round a plane passing through the posterior fontanelle and the tip of the chin. 18 inches (45 cm.).

2. *Occipito-frontal*—round a plane passing through the posterior fontanelle and the frontal eminences. 14 inches (35 cm.).

3. *Suboccipito-bregmatic*—round a plane passing through the centre of the bregma and a point midway between the occipital protuberance and the foramen magnum. $11\frac{1}{2}$ inches (28.7 cm.).

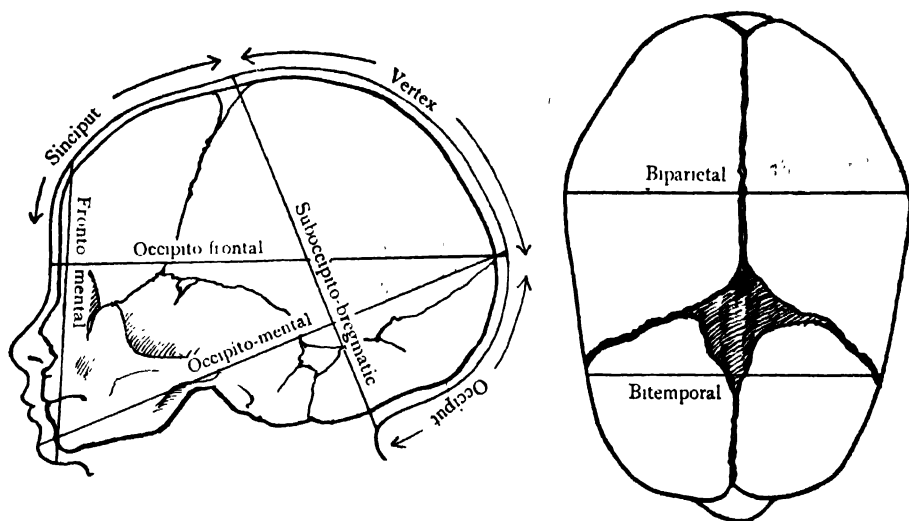


FIG. 119.—Diameters of Fœtal Head.

Movements of the Head.—The mobility of the foetal head on the trunk is a matter of great moment during labour. It enables the head to adapt itself best to the position in the pelvis in which it happens to be at any one moment. The changes are imposed on it, firstly, by the driving force of the uterine contractions from above, and secondly, by the changing shape of the pelvis as descent takes place. The meaning of these phenomena will become apparent in the chapter devoted to the mechanism of labour.

The head can undergo *flexion* till the chin is pressed hard against the chest and *extension* till the occiput touches the back. In addition a considerable degree of *lateral flexion* is possible. It can rotate safely through a quarter of a circle (90°) and in some cases *rotation* or *torsion* beyond this apparently occurs without injury to the cerebro-vertebral articulation. We have definite evidence of this from radiographs taken during labour.

II. THE PASSAGE

The general anatomy of the bony pelvis and of the soft structures of the birth canal—the uterus, vagina and the pelvic floor—have been described in Chapters I and II. The changes which these undergo during pregnancy have been noted in Chapter VI (pp. 121-125). Here fall to be considered the changes in the birth canal that occur during the process of labour. This subject has been very fully investigated by means of frozen sections made on women who have died during the later weeks of pregnancy or during labour. “The Anatomy of Labour,” by Freeland Barbour,¹ is the best monograph on the subject in the English language.

Changes in Soft Structures of Birth Canal.—During labour the uterus exhibits two complementary processes—Contraction and Retraction. The nature of uterine *contraction* is considered in a later paragraph.

Retraction consists of a gradual permanent shortening of the “upper segment” of the uterus as labour progresses, so that between the pains the diminution in the length caused by the contractions does not completely pass off. The natural and inevitable shortening of the retracting womb in the early stages of labour must, therefore, be to cause a dragging upwards or shortening of the “upper segment” and an increase in the vertical length of the “lower segment” (Figs. 118, 119). The cervix being fixed by the paracervical tissue is only very slightly altered in position—there is little if any dragging of the dilated cervix over the foetal head. In addition there results a gradual *uprising of the bladder* into the abdomen during the first stage of labour. The bladder is pulled up and the utero-vesical pouch is raised. Eventually a large part of the organ lies above the pubes. Let us explain these changes in greater detail.

During labour the womb becomes divided into two distinct portions, an upper retracting and thickening portion and a lower dilating and thinning portion or LOWER UTERINE SEGMENT (Fig. 120). The distinction between these two uterine segments becomes specially pronounced when labour is well advanced, though there is a certain demarcation present even in the latter months of pregnancy (p. 125). The difference is founded on the fact that the upper segment is the more muscular part, whilst the lower segment is less muscular and more fibrous. When viewed from within a more or less circular ridge runs round the uterus, indicating the abrupt line of demarcation between the segments. This RETRACTION RING, OR BANDL'S RING, as it is called, is formed by the lower margin of the thickened muscle above and is exaggerated by the bulging of the lower segment immediately below it (Figs. 118, 120). The more the lower segment stretches the more marked the retraction ring becomes and the higher up it rises. In cases

¹ Freeland Barbour, A. H., *Atlas of the Anatomy of Labour Exhibited in Frozen Sections*, Edinburgh (1896).

of obstructed labour the ring may be visible as a ridge crossing the abdomen and rising higher and higher with the progressive thinning out of the lower segment. Such an appearance denotes the imminence of uterine rupture, which when it occurs naturally takes place through the attenuated lower segment (p. 599).

The demarcation of lower segment from the fully dilated cervix is not so well defined, although in frozen sections at this stage there is a ridge marking the internal os which is the boundary line of this area. Until recent years the area of the uterus from which the

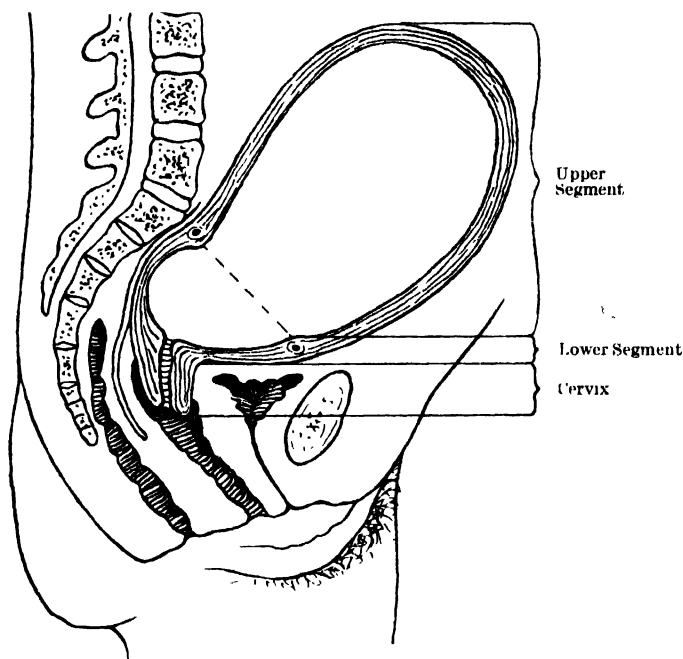


FIG. 120—Parturient Canal before Labour begins. At this stage the “lower segment” is seldom so deep or long vertically as here shown.

“lower uterine segment” arose was much debated—some maintained that it arose from the lower part of the uterine body, others that it was formed entirely of stretched-out cervix. To-day, however, as already pointed out, there is consensus of opinion that it is derived from the special area known as the *isthmus* (p. 21).

Dilatation of the Cervix and Formation of Bag of Waters.—At the beginning of labour the cervix is closed (Fig. 121), though in a multigravida a certain degree of opening of the upper part of the cervical canal or “shortening” may be present before labour starts—in some the cervix is so soft and flaccid that the external os itself may admit one or even two fingers. In a primigravida the cervix remains closed throughout till labour starts.

To begin with, the membranes (amnion and chorion) bridge across the internal os loosely, but with each pain the uterine pressure rises and the lower portion of the membranes tends to push through and dilate the internal os. As the os dilates, the lower pole of the membranes points through into the upper part of the cervical canal as the BAG OF WATERS (Figs. 121, 122). The bag of waters, so long as it remains intact, forms a fluid wedge that is forced more and more down with the succeeding uterine contractions, and in this ideal manner the cervix is dilated. Eventually it can be felt as a tight cone which bulges through the external os with each pain. Entering into the formation of the bag is some of the thinned-out decidua of the lower uterine segment, for as the membranes stretch and descend they must tear away to a corresponding extent from the uterine wall. This separation of the membranes early in labour is the origin of the slight bleeding or *show* which may occur then.

As the result of the influences mentioned above, the cervix, then,

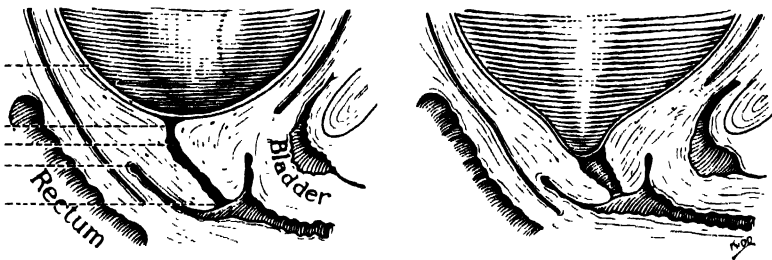


FIG. 121.—Process of Obliteration or “Taking Up” of Cervix by which its canal becomes continuous with the lower uterine segment.

is gradually dilated. The internal os first opens, and then the canal expands from above downwards. This process is called shortening or “taking up” of the cervix, for, as the upper part becomes opened out, it merges or is “taken up” into the lower uterine segment. It is then unrecognisable by the examining fingers, which get the impression that the cervix is becoming shorter.

Eventually the whole cervix is “taken up” and the external os begins to open. The cervix throughout its length now lies flush against the bag of waters or the head of the child, and the thinned-out margin of the external os is felt below. In a primigravida this margin may be resistant and knife-like to feel during a pain (Fig. 122).

With each succeeding pain the os opens gradually more and more until dilatation is sufficient to allow of the passage of the head into the vagina. This is the stage of full dilatation and, as we shall see, it ushers in the second stage of labour. When fully dilated the cervix has a diameter of 4 inches (10 cm.).

For convenience the dilatation of os externum as labour progresses is compared to the sizes of coins—thus the cervix is said to be dilated

to the size of a threepenny piece, a sixpence, a shilling, half a crown, and so on. Commonly, also, the cervix is said to admit so many fingers—one, two, or more, as the case may be.

With the opening up of the cervix the bag of waters descends more and more, followed by the head. The bag may pout as a fairly large spherical or rounded swelling into the vagina, becoming tense with each pain as the intrauterine pressure rises. The head at this stage may appear to recede, but this only happens if it is not fixed in the pelvic inlet. Eventually, when dilatation is complete, or sometimes before, the bag ruptures at the height of a pain, allowing the escape of the *forewaters*—i.e. the liquor amnii which occupies the bag and which therefore lies below the advancing head. In a normal case the head has by this time passed into the pelvis and is closely grasped by the cervix. The cervical canal is plugged by the head and the bulk of the liquor amnii is retained in the uterus. It is not, as a matter of fact, till the end of labour that the retained liquor amnii, termed *residual waters*, escapes as a gush after the delivery of the child's body.

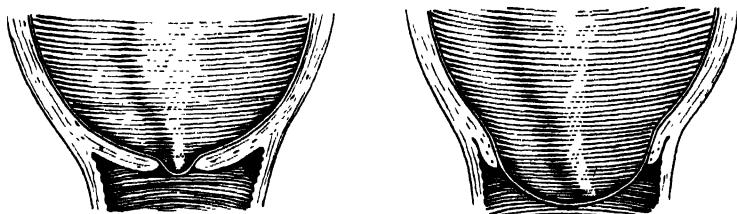


FIG. 122.—Dilatation of Os Externum.

If for any reason the presenting part of the fœtus does not descend readily into the pelvis with the progress of labour, the waters are not held back by the plugging action of the fœtus. In these cases, with each succeeding pain, the bag of membranes is pushed through farther and farther into the vagina, where it projects as a large sausage-shaped or conical swelling. The discovery of this phenomenon should always rouse in the mind of the attendant that there is something amiss. It is a common condition, as we shall see, in cases of pelvic deformity, in breech presentation, and in other malpresentations. As the unduly dilated bag is forced farther and farther down, it is unsupported and it receives the full force of the intrauterine pressure during a pain. The result is, therefore, *premature rupture of the bag of waters*. This may cause delay, because the wedge-like, dilating action of the bag is removed too early in labour. Such labours are called “dry” because the waters usually drain away completely early in labour. In some instances, especially in abnormal presentations, the membranes may rupture before the actual commencement of labour.

Sometimes, even during an otherwise normal labour, the membranes are so thick that the bag does not rupture spontaneously even after

full dilatation of the cervix. In such cases of *delayed rupture* the bag of membranes has to be perforated artificially by a sharp-pointed instrument. Very occasionally, when the labour is very rapid or when the patient has no proper medical supervision, the child is born completely enclosed in the membranes. It is then said to be born with a "caul," a happening which in the minds of the laity is still occasionally supposed to augur good luck for the newborn child; amongst seafaring people there are still some who believe that the possession of a dried "caul" is a protection against drowning.

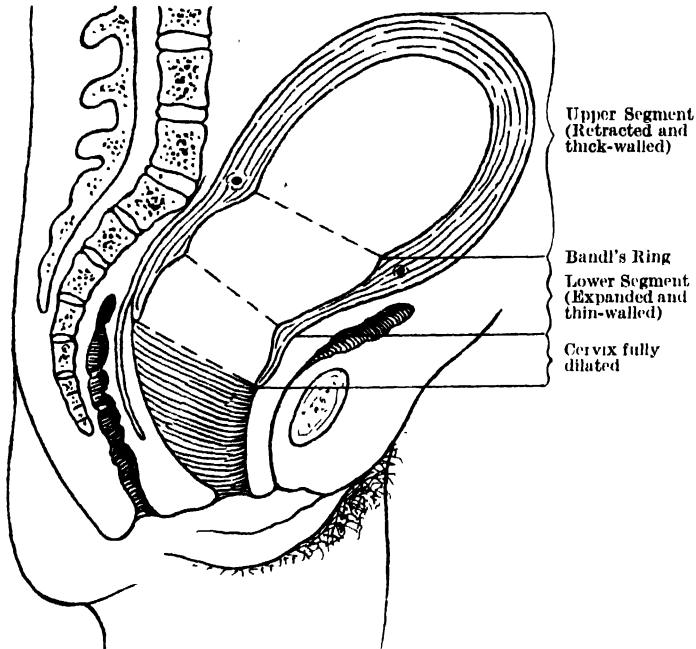


FIG. 123.—Parturient Canal at End of Second Stage.

Here is seen the retracted upper segment, increase in depth of lower segment, a fully dilated cervix, and a vagina distended by child's head which has reached the outlet.

The vagina is dilated as the child is driven farther and farther down by the contracting and retracting uterus. The mode of dilatation of the vaginal outlet and the perineum are more appropriately described under "The Phenomena of Labour."

III. THE POWERS—THE FORCES OF LABOUR

The powers that determine the descent and expulsion of the child are: (1) Primary, and (2) Secondary or Auxiliary.

(1) **The Primary Powers.**—These are the contractions of the uterus and are far the more important.

The uterine contractions or "pains" that usher in labour correspond in their nature to the intermittent contractions of the womb that occur during the whole of pregnancy, and that occur to some extent even in the non-pregnant organ. At these times the contractions are painless, and the woman is unaware of their presence. The contractions of labour are painful, the pain being most evident during the height of the contraction. The pain starts in the lumbo-sacral region and comes round to the front and down the thighs. The pain is due partly to the uterine spasm and partly to the stretching of the cervix and the vagina as these canals dilate. It may also, to some degree, be due to pressure on the pelvic nerves by the descending head.

The amount of pain felt varies greatly in different women. In some it is an almost intolerable agony even from the earliest stage of labour, whilst other women may almost complete their labour without much discomfort. Some women have no pain whatever in the first stage.

The uterine pains are *rhythmic*, the intervals between them gradually diminishing from ten to fifteen minutes at the beginning to one minute or less towards the end of labour. Sometimes, especially in the early stages of labour, the pains are irregular in time, and it not infrequently happens that after persisting for an hour or so they disappear for a time. The individual pains have a gradually increasing intensity, and have periods of increment, acme, and decrement, the whole process occupying thirty seconds or less. Moreover, as labour progresses, the intensity of the succeeding pains increases. To begin with they may be barely perceptible, whilst towards the end of the second stage of labour they may be extremely painful, causing the patient to cry out or scream in agony. Different women vary in the way they react to the pains. A nervous, highly strung woman may shout in such an uncontrolled manner as to alarm those about her, whilst the phlegmatic or self-disciplined woman, who may be suffering as acutely, only reveals this suffering in the tenseness of her facial expression. It is said that women of high civilisation suffer more during the pangs of labour than their less civilised sisters.

The *intermittent* character of the pains has a twofold result. It prevents undue exhaustion of the mother. But even more important than this is the fact that during the height of the spasm the uterus is so tightly contracted that the placental circulation is interfered with, if not entirely suspended. A long-continued spasm would thus seriously impair the circulation of the child and might even cause a fatal issue, a result that may attend the injudicious use of uterine stimulants—*e.g.* ergot and pituitary extract.

The uterine contractions are *involuntary*. They may be present in coma, narcosis or paraplegia. Whilst this is so they may be influenced by emotion, such as fright, or by reflex causes, such as an over-distension of the bladder or a loaded rectum. Influences of the kind

just mentioned, if they affect the pains, do this rather in the direction of inhibition than of stimulation, although a sudden shock or the reflex effect of a strong purge may initiate labour pains.

The actual contractions are said to be peristaltic, the waves passing along the womb from fundus to cervix. The rate of the wave is so rapid that it cannot be observed by the ordinary methods of examination.

The pains just described are often called *true labour pains* to distinguish them from *false or spurious pains*, which are felt mostly in the abdomen, vary greatly in their site, intensity and periodicity, and, moreover, have no effect in causing dilatation of the cervix. Such spurious pains are generally removed by treating the cause—*e.g.* by emptying the bladder or bowel. They are often troublesome in a nervous patient, and may cause so much discomfort and disturb her sleep to such an extent as to necessitate the administration of opium or morphia.

(2) **The Secondary or Auxiliary Powers.**—They are supplied chiefly by the contraction of the abdominal muscles which during the second stage of labour play a considerable part in driving the head down. The action of these muscles is almost entirely involuntary. During the height of a uterine pain the woman makes forcible expiratory efforts, or “bearing down,” to aid the uterus. These become more and more forceful as the presenting part is driven against the pelvic floor. If these “bearing down” efforts are made before the presenting part has reached the pelvic floor they are quite futile, and only tire the patient unnecessarily (p. 403).

The muscle wall of the vagina plays but a meagre part in expulsion.

The muscles of the pelvic floor play an indirect part in aiding the mechanism of labour. It is obvious that their contraction will impede the progress of the head. With the passing off of the intermittent expulsive efforts of the womb they tend to drive the head back into the pelvis. This up and down movement has the effect of gradually stretching the pelvic floor. The child, as we shall see, is born by a *resultant* of the forces driving the head downwards and the resistance of the perineum directing it upwards and forwards.

Gravity in ancient days was believed to play an important rôle in the descent of the child. Whilst the patient is walking about in the first stage of labour, the weight of the child may have some influence, but it must be very slight.

Effects of Uterine Contractions.—During a true pain the uterus becomes harder and the fundus comes forward till the longitudinal axis of the uterus lies approximately in the axis of the brim. In addition, as labour advances, the lower uterine segment and the cervix become stretched and dilated.

It has been pointed out above that during a pain the uterus becomes hard and the vessels carrying blood to the placenta become closed, so

that the placental circulation is suspended during the height of a pain. The effect of this on the foetus is seen in the *slowing of the foetal heart*.^L

During a pain there are, also, usually some well-marked general phenomena to be observed in the mother. The arterial pressure is raised and the pulse is quickened. During the height of the pain the respirations are slower or suspended for a few seconds during the extreme bearing-down efforts. These efforts involve an enormous expenditure of energy; hence the importance of supplying the parturient with sugar and starches to combat the tendency to pronounced acidosis (p. 403).

CHAPTER XIX

THE PHENOMENA OF LABOUR

Premonitory Stage—First Stage—Second Stage—Third Stage.

THE causes of the onset of labour have been discussed in an earlier chapter (p. 184). Labour is divided into three stages as follows : (1) Stage of Dilatation, from the commencement of labour to the full dilatation of the cervix ; (2) Stage of Expulsion, from full dilatation of the cervix to complete expulsion of the child from the vagina ; (3) Stage of Placental Separation and Expulsion—*i.e.* from the time when the child is expelled to the time when the placenta is expelled. Besides these three stages a Premonitory Stage is often referred to.

Premonitory Stage.—This is of variable duration, the features which characterise it appearing several days or a week or two before labour. Very commonly about a fortnight before labour the woman experiences the sensation of “lightening.” This phenomenon is due to a sinking of the uterus to a lower level. Discomfort she may have had in breathing due to the pressure of the womb on the diaphragm may disappear. On the other hand, pressure on the bladder with frequency of micturition may be aggravated, and there may be greater difficulty in walking as a result of relaxation in the joints of the pelvis (p. 121).

In a primigravida one important effect of the sinking of the womb is that the head of the child passes into the brim, unless there is any disproportion between it and the pelvis—it becomes fixed or “engaged.” In multigravidæ, on the other hand, engagement does not usually occur till labour commences and sometimes not until it is well advanced.

In many cases, especially in multigravidæ, the upper part of the cervix becomes “taken up” in the latter weeks—*i.e.* the cervical canal is obliterated from the internal os downwards (*vide* p. 370).

In addition to these changes a progressive softening of the vaginal walls and the vulva occurs and there is usually an increase in the vaginal discharge. Relaxation of pelvic joints also occurs (p. 121).

First Stage.—This is the stage lasting from the commencement of labour to full dilatation of the cervix. The commencement of labour is indicated by (1) the development of rhythmic uterine contractions ; (2) dilatation of the os externum ; and (3) the escape of a blood-stained discharge termed “the show.”

The anatomical changes in the uterus and the cervix during the

first stage, the mode of formation of the bag of membranes, and the other phenomena which belong to the first stage, have been described in the preceding chapter.

The rapidity with which the cervix dilates varies greatly in different cases and depends, in the first place, on the strength and frequency of the uterine efforts, and, in the second place, on the rigidity of the cervical tissues—these conditions vary greatly in different women. Other things being equal, dilatation is slower with the more rigid cervix of the primipara than with the softer, more dilatable parts of the multipara. The time required for complete dilatation varies greatly. In a primipara the average is fourteen hours; but in a multipara it may be very much shorter.

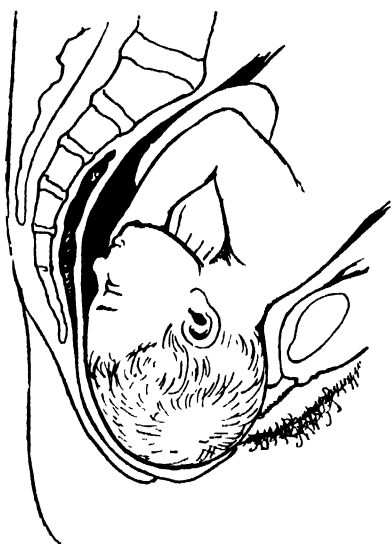


FIG. 124.—Head bulging the Perineum.

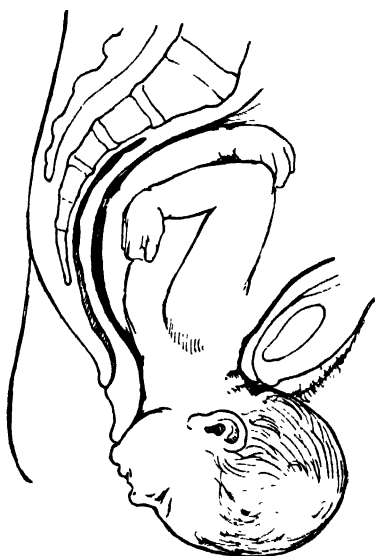


FIG. 125.—Delivery of the Head.

Second Stage.—This lasts from full dilatation of the cervix to expulsion of the child. Rupture of the membranes usually occurs when the dilatation is complete or nearly so. Thereafter there may be an interval during which the pains cease. This respite is only short, for the pains soon recur with redoubled force and greater frequency, and now, for the first time, the patient has a distinct sensation of “bearing down” due to pressure on the pelvic floor. The patient can be seen and heard to be making forcible expulsive efforts at the height of the pains, and from this and the evident increase in the severity of the pains one can usually tell, even without an examination of the patient, that the second stage has been reached.

The child is now forced down by direct pressure of the uterine walls. During its descent it executes a series of movements which will be described under “The Mechanism of Labour.” The descending

head dilates the vaginal walls from above downward, and is grasped firmly all around by these walls. The lowermost part of the head is, however, free from pressure, and on this area an œdematous swelling forms which enlarges its site with the changing movements of the

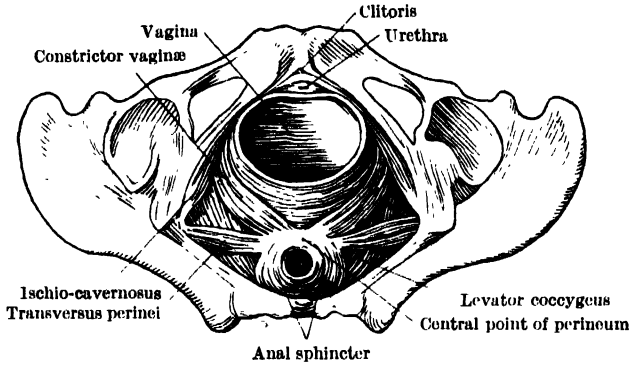


FIG. 126—Dissection of Pelvic Floor when fully distended during parturition (crowning).

head. This is the *caput succedaneum*. It is due to a transudation of fluid from the vessels of the scalp, and forms only on the heads of living children. It comes up for description more appropriately under “The Mechanism of Labour.”

The head eventually presses downwards on the pelvic floor, which

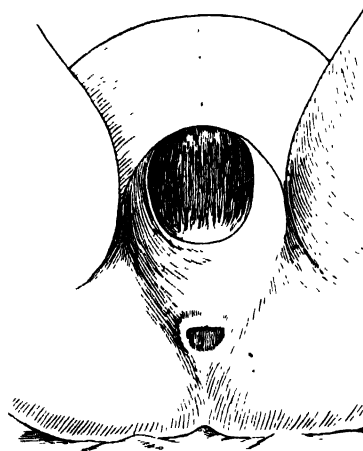


FIG. 127.—“Crowning” of the Head.

becomes bulged in front of it (Fig. 127). The perineum becomes stretched out more and more over the advancing head, the anterior margin of the anus is pulled forward, exposing a D-shaped area of the anterior wall of the bowel. The head appears at the vulvar orifice, which becomes more and more dilated, until the greatest circumference

of the head escapes; this is called *crowning* of the head. The vulvar orifice now retracts over the remainder of the head (Fig. 125), the shoulders escape and the trunk quickly follows, along with the "residual waters." There is usually little or no bleeding because the placenta is still adherent.

During the emergence of the head the fourchette in a primipara is usually torn, and the broad shoulders may enlarge this tear.

After the head of the child escapes, but not till then, the fundus of the uterus sinks down, and it sinks progressively lower as the trunk escapes. The reason why the fundus does not sink until the head is born is because the child's trunk becomes straightened out as the uterine wall is brought into direct contact with it after the membranes rupture. This sinking of the uterus is due to the retraction of the uterine muscle, so that at the end of the second stage of labour the uterine cavity has shrunk from a space large enough to hold child, placenta and waters to one just big enough to hold the placenta.

Immediately after its birth the child should cry lustily.

The duration of the second stage is about forty to sixty minutes in a multipara and about two and a half hours in a primipara.

Third Stage.—This is the stage of separation and expulsion of the placenta. The uterine fundus at the beginning of this stage is at the level of the umbilicus and the uterus is a broad and globular structure. After the birth of the child a period of quiescence sets in, lasting for some minutes—very often ten to fifteen minutes—during which the pains or contractions are suspended. Thereafter they recommence and, in a normal case, separation of the placenta begins, and continues gradually.

When separation is complete the placenta slips into the "lower uterine segment" (Fig. 128), marked by a slight rise of the fundus: the lower part of the uterus is felt to become broader. The placenta then passes into the vagina. As the placenta descends, more and more of the cord passes out of the vagina. The placenta then escapes completely, dragging the membranes after it. After expulsion of the placenta, the fundus sinks down at first and then it rises a little higher. With the escape of the placenta it continues *retracted* and at intervals becomes firmly *contracted* like a "cricket-ball."

The actual manner in which the separation of the placenta from the uterine wall takes place has been a topic of many discussions. There are three processes which, acting individually or in combination, cause the separation: (1) Diminution of the placental site as the womb retracts. If this diminution be greater in proportion to the lessening size of the placenta as a result of its being squeezed and of its blood being forced out of it, there must be a tearing through of the placental attachments. (2) The alternate contractions and relaxations of the uterus, which tend also to loosen the attachments. (3) Hæmorrhage between the placenta and the uterine wall (*retroplacental hæmatoma*).

The placenta usually escapes edge first, though in some cases it may escape doubled up with the amniotic surface first, like an umbrella turned inside out (Fig. 128). This is the natural process in cases where there is a large retroplacental hæmatoma, where the placenta was attached to the fundus and in cases where traction is made on the umbilical cord.

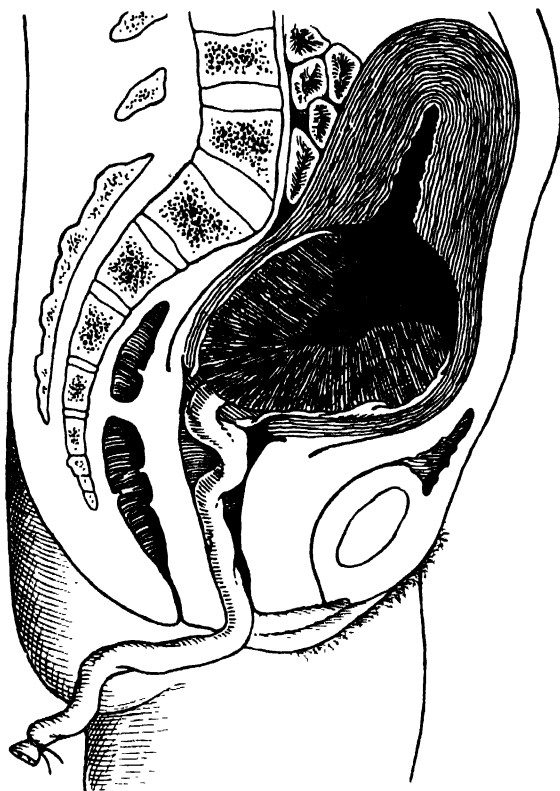


FIG. 128.—Third Stage. Placenta in Lower Uterine Segment.

Note descent of placenta has brought ligature on cord farther away from vaginal orifice, and distension and widening of the lower segment referred to in text.

The separation of the placenta from the uterine wall entails the tearing across of many large vessels whose ends are left open. But in a normal case there is little hæmorrhage because the retraction of the uterus causes a muscular closure of the large sinuses in the uterine wall, and the obliteration of the uterine cavity causes pressure on the open vessel mouths. Thrombosis quickly confirms this mechanical closure. The line of cleavage is through the stratum spongiosum (p. 83).

The third stage of labour normally lasts on an average twenty to thirty minutes (*vide* p. 410).

CHAPTER XX

PRESENTATION AND POSITION OF THE CHILD— METHODS OF OBSTETRICAL EXAMINATION

BEFORE we consider the mechanism and management of a normal case of labour, a description must be given of the different ways in which a child may lie in the uterus before labour actually commences and the different ways in which it may enter the pelvis with the onset of labour. Definitions of some terms often used in dealing with these questions must first be given.

The **ATTITUDE** of the child is defined as the relationship of the different parts to one another. As we have seen in a preceding chapter, the attitude generally adopted by the child *in utero* is one of flexion of the head, limbs and body.

The **PRESENTATION** or "*lie*" is defined in terms of that part of the child which occupies the lower pole of the uterus and which "presents" during labour. When the "*lie*" of the fœtus is such that its long axis coincides with that of the womb the presentation may be either (1) *Cranial* or (2) *Breech*, according as the head or the breech presents. On the other hand, the long axis of the child, instead of lying longitudinally in the uterus, may lie across it, when the presentation becomes (3) *Transverse* or *Oblique*.

The relative frequency of the different presentations is approximately :—

Cranial	.	.	.	.	96·0
Breech	.	.	.	.	3·5
Transverse or Oblique	.	.	.	.	0·5

The preponderance of cranial presentations is due to a variety of factors, the chief of which is that the narrower end of the ovoid formed by the fœtus is the head end. The uterus is an ovoid bag wider above than below, and, as the child has a free mobility in the uterus during the early months, it is natural that, with its gradual increase in size and the establishment of its irregular ovoid character, it should be constrained by the shape of the uterus to take up as a permanent position one in which the narrower cranial end is below.

Another factor tending to the presentation of the head is that the cranial is the heavier end and, at the time when the child floats freely in the amniotic sac, this end must sink lower in the uterus.

Cranial presentations are divided into (1) *vertex*; (2) *brow*; and (3) *face*, according to the part of the head of the child which overlies the internal os and advances first in labour.

Breech presentations are divided according to the part of the pelvic end of the child that advances first. (1) *Full breech*, the buttocks present first and the legs are flexed at the knee. (2) *Frank breech*, the buttocks present, but the legs are extended at the knee. (3) *Footling*, a foot presents. (4) *Knee*, the knee presents.

In a *transverse or oblique* presentation or lie it is usually the shoulder that presents (p. 475).

All presentations, except a vertex, are classed as malpresentations. The factors which tend to produce malpresentation will be discussed in later chapters. Suffice it here to say that anything which leads to a disturbance of the factors that promote a vertex presentation during pregnancy, or that interferes with an easy engagement of the head in the pelvic brim at the commencement of labour, predisposes to malpresentations. As common examples of such disturbing factors may be mentioned death or malformation of the foetus, plural pregnancy, hydramnios, contraction of the pelvis, tumours in the pelvis, and placenta prævia.

The POSITION of the child is defined as the relation of the presenting part of the child to a particular part of the pelvic brim of the mother. For each presentation a particular and convenient part of the child is taken in this connection—the *denominator*, as it is called. In vertex presentations, for example, the occiput is the denominator; in face and brow presentations, the chin; in breech presentations, the sacrum; and in transverse or oblique presentations, the shoulder. In all cases the particular parts of the mother chosen are the extremities of the oblique diameters at the brim, and in each presentation there are thus four possible positions.

VERTEX PRESENTATION

As we have seen, the normal presentation is the vertex. This part of the head presents because of the flexed attitude of the head on the chest which obtains during pregnancy.

The four possible positions of a vertex presentation are :—

1. *Left occipito-anterior* or *L.O.A.*—Here the long axis of the head lies in the right oblique diameter of the pelvic brim with the occiput anterior (Fig. 129). If the foetal head is placed at the brim of a bony pelvis in the L.O.A. position, and it is turned in the direction of the hands of a watch, the other three positions of a vertex case will be passed in succession, the head on each occasion being held with its long axis in an oblique diameter.

2. *Right occipito-anterior* or *R.O.A.*—Here the long axis of the

head lies in the left oblique diameter with the occiput anterior (Fig. 130).

3. *Right occipito-posterior* or *R.O.P.*—Here the long axis of the

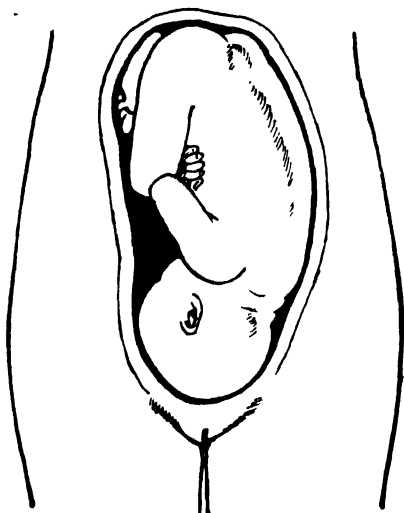


FIG. 129.—First Vertex (L.O.A.).

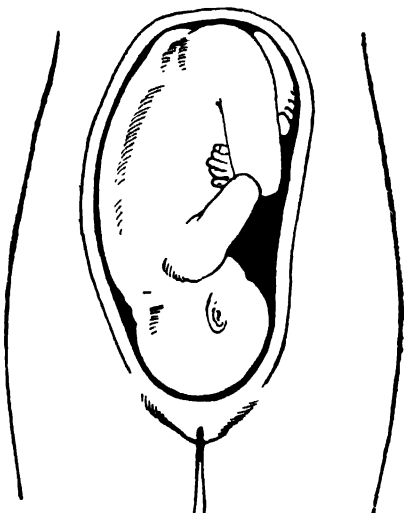


FIG. 130.—Second Vertex (R.O.A.).

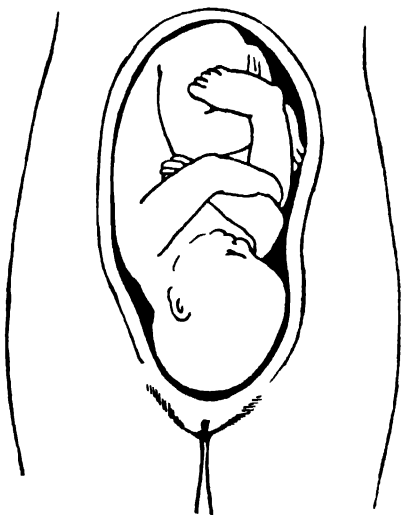


FIG. 131.—Third Vertex (R.O.P.).

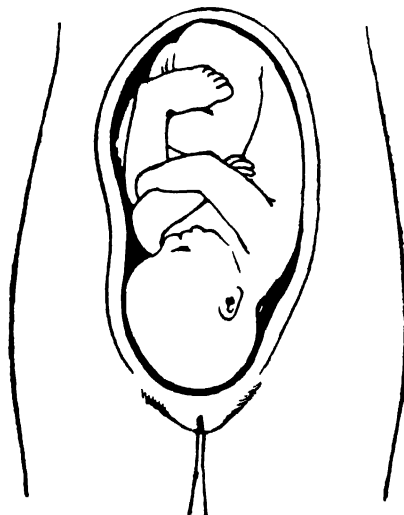


FIG. 132.—Fourth Vertex (L.O.P.).

head is in the right oblique diameter, and the occiput is posterior (Fig. 131).

4. *Left occipito-posterior* or *L.O.P.*—Here the long axis of the head is in the left oblique diameter, and the occiput is posterior (Fig. 132).

The relative percentage frequency of the different positions of the vertex after labour is in progress are as follows :—

First (L.O.A.) .	65	Third (R.O.P.) .	20
Second (R.O.A.) .	10	Fourth (L.O.P.) .	5

It will be noticed that the two most frequent positions are the first and third—that is, those in which the long axis of the foetal head occupies the right oblique diameter. The choice of this diameter in such a large number of instances (85 per cent. of the whole) is due to the fact that it provides the largest available space for the head. The left oblique diameter is occupied at its posterior end by the pelvic colon, which appreciably diminishes its total space. Also the normal torsion of the uterus to the right favours its occurrence.

It will be noted from the above figures, also, that in the large majority of cases the occiput of the child is directed to the front. This is due to the fact that the body of the child occupies the uterus more comfortably when its smooth, convex back lies in front against the smooth, concave anterior uterine wall of the mother, and when its concave ventral surface lies against the convex posterior uterine wall of the mother. The uterus during pregnancy is a flaccid bag, and it thus happens that the shape of the abdominal cavity of the mother tends to constrain the growing child to adopt a dorso-anterior position. Added to this the configuration of the lower part of the vertebral column of the mother definitely favours dorso-anterior positions.

Before labour starts, however, the long axis of the head most commonly lies in the transverse diameter of the pelvic brim. It does not definitely take up an oblique position until labour is well established. This fact was noted by a number of obstetricians before radiography confirmed their observations. This matter will be referred to later, and more particularly when occipito-posterior positions of the vertex (third and fourth) are being discussed (p. 438).

METHODS OF OBSTETRICAL EXAMINATION

The successful practice of obstetrics demands a skill in the recognition of the presentation, position, and other facts regarding the child and the mother, from abdominal examination. It cannot be too much emphasised that, after practice, the obstetrician can obtain from the external methods of examination alone—especially that of palpation—a very accurate knowledge of the presentation and position of the child and the progress of labour. The more experienced the accoucheur becomes in these means of diagnosis, *the less frequently does he have recourse to vaginal examination.* This is a matter of very great moment, for the risks of infection of a parturient woman become increased in proportion to the amount of vaginal interference practised. In recent years radiography has come to be very much employed; but the

writers of this textbook wish to stress the point that this special examination can be dispensed with except in special circumstances ; but as these special circumstances cannot always be appreciated *there is a good deal to be said for a routine X-ray examination of the pelvis in all primigravidae*. It requires to be done only once in a woman's lifetime.

Abdominal Inspection.—The woman lies on her back with the knees drawn up and the shoulders and head slightly raised by a pillow to relax the muscles of the abdominal wall. The examiner stands on the right side, and the covers are turned back sufficiently to expose the abdominal wall from xiphi-sternum to pubes.

The general shape and size of the abdominal swelling ; undue enlargement suggestive of twins, hydramnios, or a fibroid or ovarian tumour complicating pregnancy ; and the condition of the abdominal walls, as regards striæ, pigmentation, etc., are noted, and have all been referred to elsewhere (p. 164).

Abdominal Palpation.—In the later weeks of pregnancy and during the early stage of labour all necessary information regarding the presentation and position of the child can be obtained by palpation. Moreover, in most instances, one can obtain more complete information by this method than by vaginal examination. So, also, by palpation one can discover whether or not the presenting part has entered the pelvic brim. In a primigravida the foetal head ordinarily enters the pelvis one to two weeks before labour commences ; if by palpation one learns, in a primipara, that the head still moves freely above the brim, although labour has been in progress for some time, one suspects that there is some impediment due to an unduly small pelvis, to a relatively large head, or to malposition of head.

By palpation, moreover, one may recognise the presence of twins, abdominal tumours, etc. During the course of the examination the uterus is often found to exhibit intermittent contractions (p. 171).

For examination the patient lies as for inspection ; the warmed hands of the physician are laid flat on the abdomen while the patient is engaged in conversation so that her attention may be withdrawn from the examination and relaxation of the abdominal muscles thus encouraged.

The examiner should follow the same routine in all his abdominal examinations.

1. *Palpate the fundus of the uterus* by laying on both hands with the fingers directed upwards toward the chest of the mother (Fig. 133). In this way the exact position of the upper limit of the uterus is recognised. The breech usually occupies the fundus and is felt as a large, rounded body, softer and more irregular in shape than the head. Near it, to one or other side, the lower limbs of the foetus can be felt, becoming especially prominent during the foetal movements. The rounded breech end of the child is felt to pass smoothly into the

trunk and back as the fingers of the examining hand are carried downwards—there is no break or depression corresponding to the neck at the junction of the head and trunk.

If the head of the child occupies the fundus, the structure felt is harder, rounder and more regular than the breech, and the dip between the head and the anterior shoulder can be recognised. The head can usually be moved separately from the body.

2. *Palpate the front and sides of the uterus.* The curved, smooth, firm contour of the back is felt extending the full length of the uterus to one or other side of the middle line, whilst on the opposite side the small separate movable structures corresponding to the limbs are felt. Where, on the other hand, the back is lying against the posterior wall of the uterus, the examining hands are impressed by the absence of the solid resistance felt in a dorso-anterior case. Instead, the front of the



FIG. 133.—Palpation of Upper Pole of Uterus.

uterus is occupied by a multiplicity of small parts—the limbs. In such a case it is usually difficult or impossible to recognise the side on which the back lies from palpation of the upper part of the womb, though, as we shall see, this information may be gained by palpation of the head in the lower pole of the uterus.

3. *Examine the lower pole of the uterus.* First grasp the lower part of the uterus between the thumb and fingers of the right hand as shown in Fig. 134. In the case of a cephalic presentation the round, hard head will be at once grasped between the fingers if it is lying free and has not yet descended into the pelvic brim. If, on the other hand, it is a breech presentation, the fingers grasp the broader and softer mass of the breech (p. 460).

Next lay the two hands on the abdomen with the finger-tips directed to the patient's feet, and grasp the lower end of the uterus as shown in Fig. 135. If the head is well flexed and the occiput is lying to the front, there is no depression between the foetal head and back; instead the smooth back passes directly on to the head. Where, on the other

hand, the head is extended (face and brow presentations), a distinct groove is felt as the hands pass from the back on to the head (p. 449).

When the head has sunk into the brim of the pelvis it cannot be gripped between the fingers as in Fig. 134. Instead, the fingers of the

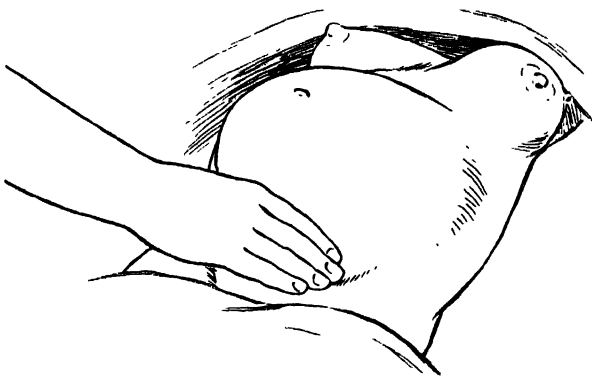


FIG. 134.—Palpation of Lower Pole. ("Pawlik grip.")

two hands have to be dipped deeply into the pelvis, as in Fig. 135, before the head is felt. It is thus clear that by abdominal palpation one can tell whether the head is engaged or not. In a multiparous patient



FIG. 135.—Palpation of Lower Pole.

engagement does not usually occur till labour commences. In a primigravida, on the other hand, as we have seen, the presenting part slips downwards and tends to become engaged some days or weeks before

the onset of labour unless there is some discrepancy between the head and the pelvis. The absence of engagement before labour in a primigravida should always rouse the suspicion of some such existing abnormality. Nevertheless, there are numerous cases—*e.g.* posterior positions of occiput—in which the head in a primigravida remains mobile till the onset of labour and yet in which the subsequent birth occurs quite normally.

He can also recognise the lie of the child in the case of a transverse or oblique presentation. In such a case the head is felt lying in one or other iliac fossa whilst the breech is lying on the opposite side, usually at a higher level.

In addition to providing useful information in breech and head presentations, abdominal palpation may enable the examiner to recognise the existence of twins—for example, if he feels two heads.

So far reference has been made to determining “presentation,” but as experience is gained the “position” of child may also be defined. Take the vertex presentations after the head has assumed a definite *first, second, third and fourth position*. If the outline sketches on p. 383 are consulted it will be easily understood how this may be done. If one stands with the arms as shown in Fig. 135 and sinks the hands into the pelvis one encounters the resistance of the occiput on one side and the sinciput on the other; but these resistances or “landmarks” are encountered at different levels in the different positions. In the *first* the left hand is lower, in the *second* the right hand is lower. Again, in the *third* the right hand is lower but not to the same degree as in the second, while in the *fourth* the left hand is lower but not to the same extent as in the first position—the reason of this is because the head is not so much flexed in third and fourth (*vide* Fig. 150, p. 440) as in first and second positions.

We have already referred to the location of the back, but we wish to stress the importance of *palpating the anterior shoulder*. As the back of the child is almost always to one or other side of the uterus—very rarely indeed is it directed directly forward or backward—the anterior shoulder can generally be defined as a bony prominence above the occiput and with a slight gap between them. If the anterior shoulder is well forward before labour, it is most unlikely that when labour starts any position other than a first or second will develop. On the contrary, if the anterior shoulder is well round towards the back, a third or fourth is quite probable (p. 439). We shall see later how the progress of descent of head during labour may be determined by noting the gradual descent of it and of the anterior shoulder (p. 404).

Auscultation.—By the use of the stethoscope the foetal heart can be heard, and its recognition provides, in the first place, a certain sign of life in the child, and, in the second place, a method of gauging the state of well-being of the child. In any condition which is associated with foetal distress—*e.g.* in a tedious or complicated labour—the rate

of the heart tends at first to increase. It then quickly begins to fall, the degree of cardiac slowing being a sure index of the foetal danger. If, instead of beating at the normal rate of 120 to 140 per minute the rate has sunk to 100 or lower, the danger is great.

In ordinary cases the heart is best auscultated when the stethoscope is placed over the back of the child. The point of maximum intensity of foetal heart sounds corresponds to the interscapular region of the child. In an ordinary vertex presentation, therefore, when the back lies to the front, the point of maximum intensity of the heart sounds is about midway between the umbilicus and the left (L.O.A.) or right anterior superior spine (R.O.A.). In occipito-posterior positions the maximum intensity is at about the same level but farther round the flanks. In breech cases the heart is best heard about the level of, or slightly above, the umbilicus and to the left or right side, depending upon the position of the child (*vide* illustration, p. 173).

Vaginal Examination.—For this examination the patient lies on her back with her thighs flexed. Details regarding this particular examination have been considered earlier in this work (p. 110)—thorough cleansing of hands and of vulva, use of gloves, etc., are described later (p. 402). After separating the labia with the fingers of his left hand, the examiner introduces the index and middle fingers of his right hand into the vagina without touching any of the vulvar structures.

The examination should be conducted under a definite system and should bring under review the following :—

1. The condition of the vaginal orifice and the vaginal walls.
2. Whether the bladder and rectum are empty or distended.
3. The cervix—the position, degree of “taking-up,” and dilatation of.
4. The membranes—whether they are ruptured or intact and, if the latter is the case, whether they are bulging unduly.
5. The presenting part—the nature of, whether head or breech or shoulder (transverse) presents. In the case of cranial presentation, the position of vertex, face, or brow.

In addition to these points the size of the pelvis should be estimated if this has not been done at the antenatal examination about the thirty-sixth week (p. 191). If the promontory of the sacrum is felt easily the pelvis is narrowed and the degree of this narrowing must be estimated by measurement. If, however, the promontory can only be felt with difficulty it can generally be assumed that there is no disproportion of any important significance. If the presenting part has descended into the pelvis to any extent it will be impossible to feel the promontory, but, in such a case, the exact measurements do not as a rule matter very much, for the fact that the presenting part has safely passed the pelvic brim usually means that the remainder of the labour will be unattended by any difficulties due to contraction of the bony pelvis. Serious contraction of pelvic outlet is a rare

complication. The whole subject of pelvic deformity is considered later (pp. 508-538).

We have already referred to the fact that, as vaginal examination is attended with the risk of infection, it should never be carried out without the clearest indication for its employment. Under ordinary circumstances one such examination is made during pregnancy, for the purpose of eliminating pelvic contraction or a tumour in the pelvis. A second examination immediately after the rupture of the membranes, to obtain assurance regarding absence of prolapse of the cord, may be necessary, but can generally be dispensed with if pelvic formation is normal and the presentation a first or second vertex (*vide* p. 383).

With the object of eliminating the risks incidental to all vaginal investigation, some obstetricians teach that the course of labour should be followed by noting the descent of the head and rotation of the anterior shoulder by means of abdominal palpation, and by noting descent of greatest intensity of the foetal heart sounds by auscultation (Fig. 139). Should they not furnish sufficient information an occasional rectal examination with the finger, encased in a rubber finger-stall, will supply the necessary information. These matters are dealt with more fully in the chapter on the Management of Labour.

CHAPTER XXI

MECHANISM OF LABOUR

BY mechanism is meant the sequence of changes which occur in the position of the presenting and other parts of the child during its descent through the maternal passages.

Our knowledge of the mechanism of labour has been gained from (a) vaginal examinations during labour; (b) frozen sections of women who have died during labour; and (c) radiography during labour. Each has contributed its quota. It is probable that the last-mentioned method, by reason of its exactness, will prove most informative.

In this chapter the mechanism of labour in the first and second vertex positions—the ideal positions of the vertex—is described in the light of our present knowledge.

FIRST VERTEX POSITION (L.O.A.)

We have already seen (p. 384) that prior to labour the long axis of the head in the majority of cases lies in the transverse diameter of the pelvic inlet and moderately fixed, the fixation being in general more marked in the primigravida than in the multigravida. With the onset of labour the head comes to adjust itself and to take up a position in the oblique diameter (Fig. 129). There are, of course, a number of cases in which the head occupies primarily an oblique position.

Radiological study confirms the view long held by many obstetricians that before engagement the head normally rests on the pelvic brim with the sagittal suture nearer the pubes than the promontory and with the posterior parietal bone presenting (posterior asynclitism). This attitude, however, is unstable, because should the patient change her position from the dorsal (the position in which most observations are made) to the lateral or erect, the position and attitude of the foetal head may also become altered (*vide* p. 396).

Coming now to the early stages of labour, it is found that under normal conditions of pelvis and foetal head this posterior asynclitism gradually disappears and the occipito-frontal diameter of the child's head, by reason of flexion, comes to be parallel, or approximately parallel, to the plane of the pelvic brim. With synclitism and increased flexion established, the child's head enters the pelvis in the ideal

attitude and swings into the oblique diameter or remains for some time in the transverse. If, however, there is any departure from the normal in pelvic formation, then many variations in attitude and position of head may occur (e.g. occipito-posterior, face, brow positions).

During the whole of labour *descent* occurs. The special movements of the head that take place and require to be studied in detail are : (1) *Flexion*, (2) *Internal rotation*, (3) *Extension* and (4) *External rotation* or *restitution*.

(1) *Flexion*.—This consists of an exaggeration of the flexion of the head on the body which is present before labour commences. The movement is due to the resistance offered by the pelvic brim to the presenting part ; it tends to press the child's chin more up against

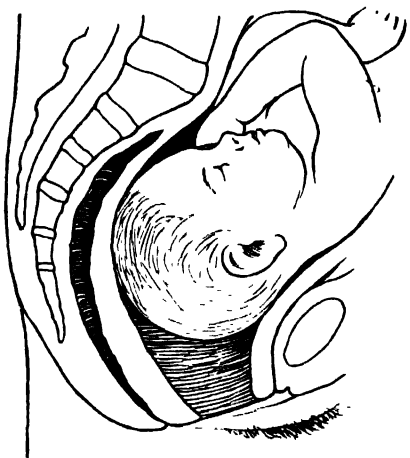


FIG. 136.—Head fully flexed and rotating into Conjugate Diameter. This is the level at which the head encounters resistance of pelvic floor.

its chest. It is thus easy to see how the degree of flexion varies with the degree of resistance encountered, being least where there is a small head or a roomy pelvis and most when the head is larger or the pelvis is narrow in all its diameters (Justomino Pelvis, p. 509).

The simple explanation just given probably accounts amply for the increased flexion, which accompanies descent. In the past, several theories have been advanced to account for it. For example, there was the *lever theory*. According to this conception, the fact that the spinal column is attached to the head nearer the

occipital end means that the downward pressure, exerted on the child's trunk by the retracting uterus, will be most effective on the occipital end of the head and this end will descend more than the sincipital end.

The mechanical effect of flexion is that the head engages in the short suboccipito-bregmatic diameter ; thus the head is swung into the diameter which allows of easiest descent, as stated in the opening paragraph.

(2) *Internal Rotation*.—During descent the long axis of the head gradually changes in direction, the occipital part moving farther and farther forward toward the pubic arch until, when internal rotation is complete, the long axis of the head has moved into, or nearly into, the conjugate diameter of the maternal pelvis (Figs. 124, 125).

The exact site and cause of this movement have given rise to much discussion. It is generally believed that it commences when

the lower end of the head reaches the pelvic floor, after which it accompanies descent until complete rotation occurs. The total movement thus exhibited by the head during this stage is a sort of spiral or corkscrew-like movement.

The *cause* was formerly ascribed to the anatomical conformation of the pelvic floor and the maternal passage. The latter may be considered as consisting of a curved cylinder, though it only actually opens out to form the cylindrical passage during the downward passage of the child. The pelvic floor, through which the cylindrical passage or vagina passes, has a gutter-like shape, formed by its lateral halves shelving towards the middle line. But there is a shelving also from behind forward (pp. 35-36). The natural tendency will be for the descending occipital pole of the head to be constrained more and more into the forward depth of the gutter as it descends, for flexion to be maintained and for the occiput to sweep more and more inwards and forwards until the long axis of the head is eventually directed into the antero-posterior diameter of the canal. The resilient contraction of the levator ani and other muscles of the pelvic floor have a special influence in determining this rotation. Between the pains as the resilient contraction passes off there is a tendency for the long axis of the head to go back a little into an oblique position—this can be noticed when one is performing an extraction with forceps with foetal head at pelvic outlet.

Other factors have been invoked to explain this rotation and more especially to explain the "long rotation" in occipito-posterior positions (*q.v.*, p. 441). For example, Sellheim, de Snoo, Young and Moir describe varying flexibilities of foetal mass as a whole, and of foetal axis *re* head and trunk. They point out that the lower end of the foetal mass (cylinder) in the case of the average child passing along the curved canal of the average-sized pelvis must bend backward (extension) if it is to descend. This movement becomes possible only as the result of rotation. Sellheim's analogy of a foot being pushed obliquely into a shoe expresses the mechanism simply as it occurs in one plane. In order to pass into the shoe the foot must rotate into the axis of the shoe. The process is similar in regard to head and pelvis, but here the advance of the head *as the result of rotation* occurs in two planes (the plane of rotation and the plane of descent), and the movement is, therefore, spiral in nature.

The study of the mechanism of birth by radiography has demonstrated: (a) That if the pelvis is of the normal female type the occiput rotates forwards no matter whether it starts off anterior or posterior; (b) that any departure from the normal pelvic formation favours a rotation backwards of the occiput (p. 438). Pelvic formation, adjustment of head to pelvic formation, pelvic floor and flexibilities of foetal axis all play a part; but the primary influencing factors are pelvic formation and pelvic floor.

(3) *Extension*.—This consists in an undoing of the flexion of the foetal head. *Extension occurs during the actual escape of the head from the maternal passages and after the occipital end of the head is born nearly as far as the suboccipito-bregmatic diameter.* What actually occurs is that the occiput is born round the symphysis pubis, extension occurring at the last stage (Fig. 125, p. 377). *There is no hitching of the occiput at the symphysis pubis.* Frozen sections demonstrate that earlier extension does not occur. It will be noted that in every textbook it is recommended that in guiding the exit of the head flexion should be maintained; and all are in agreement that by doing so one lessens the risk of perineal rupture because the suboccipito-bregmatic circumference is in alignment to the plane of the birth canal.

The exact *cause* of this so-called birth by extension is the resultant of the forces of the uterine contractions driving the head downwards and backwards and the resistance of the pelvic floor driving it upwards and forwards.

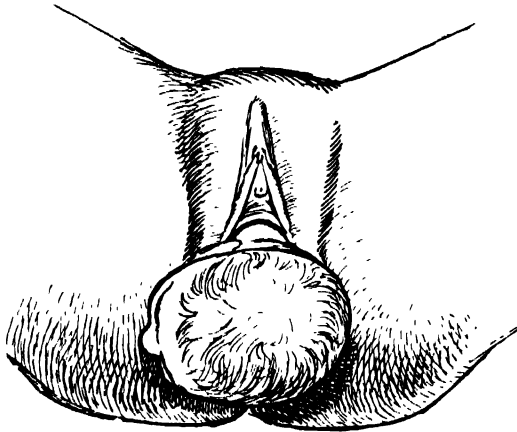


FIG. 137.—External Rotation.

(4) *Restitution and External Rotation*.—During the birth of the head the trunk of the child descends and the anterior shoulder comes more forward although the shoulders still retain a slightly oblique position. Then as the shoulders descend and rotate into the conjugate diameter of the pelvis the head undergoes an external rotation which brings it into its original oblique position—hence the name given, *restitution* (Fig. 137).

Birth of Shoulders.—Descent of the shoulders is as described above. The anterior shoulder as it is pushed more and more downwards is pressed against the symphysis pubis, whilst the posterior shoulder sweeps over the perineum.

The birth of the shoulders and arms is quickly followed by the birth of the rest of the *trunk* and legs.

CAPUT SUCCEDANEUM.—During labour the head is grasped firmly by the maternal soft parts except at the area which is immediately related to the place where the birth canal is opening in advance of the head. This area on the head, encircled by what is called the *girdle of contact*, becomes the seat of an œdematous swelling. This swelling is due to the pressure of the maternal passages against the scalp and the interference with the free venous return in the vessels of the scalp, the œdematous infiltration occurring naturally over the area which is free of pressure.

The site of this caput succedaneum varies with the position of the head. In a first vertex case at the beginning of labour it lies on the vertex to the right of the sagittal suture. In a second vertex case it lies on the corresponding site on the opposite side. As flexion increases with advancing labour the caput moves backwards, eventually lying over the posterior fontanelle.

The “caput” becomes more and more pronounced as labour progresses, and it is often so marked as to obscure considerably the landmarks on the foetal skull used for the diagnosis of the position.

The caput may become very pronounced in cases of difficult labour where the head lies long in the pelvis (p. 429). It is usually a very temporary swelling disappearing almost completely twenty-four hours after birth. In this it differs from the *cephalo-hæmatoma*, an effusion of blood under the pericranium, and described elsewhere (p. 610).

MOULDING OF THE HEAD.—We have already seen in the chapter devoted to the anatomy of the foetal skull that the bones of the vault are loosely fixed together, being separated by soft membranous sutures that allow of a considerable play between the adjacent bones. During labour this play manifests itself in an overriding of the bones or moulding, a mechanism which allows of a diminution in the size of the head. The occipital bone and the two frontals are driven slightly under the parietals. The parietal bone which is posterior is exposed to a greater pressure by the maternal parts than that which lies anteriorly; the posterior parietal is thus driven under the anterior. These mouldings result in a diminution in both the suboccipito-bregmatic and occipito-frontal diameters.

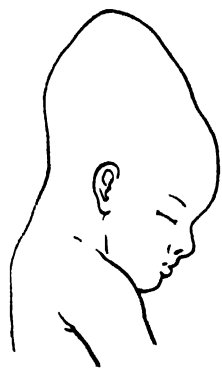


FIG. 138.—Moulding of Foetal Head.

As in the case of the caput succedaneum, the moulding increases with the duration of labour and the degree of pressure to which the head is subjected. It may be absent in an easy labour, whereas it may occur to dangerous limits in a difficult labour, and in such it is apt to result in intracranial hæmorrhage (p. 614).

NÆGELE AND LITZMANN'S OBLIQUITY.—Besides the movements and alterations in attitude referred to in the preceding paragraphs, it is

frequently found that the sagittal suture does not run across the pelvis in true diagonal fashion. Not infrequently the head is tilted to one or other shoulder, which causes the sagittal suture to be nearer the promontory in the one case, or the symphysis pubis in the other. If it is nearer the promontory, one speaks of the head as having an anterior parietal presentation or anterior asynclitism (Nægele Obliquity). If it is nearer the pubes the head is said to have a posterior parietal presentation or posterior asynclitism (Litzmann's Obliquity). This question, as we shall see, is of great importance in connection with the mechanism of labour in flat pelvis (p. 515).

MECHANISM IN SECOND VERTEX POSITION (R.O.A.)

The head (Fig. 130) engages with the long diameter in the left oblique diameter of the brim. The movements of mechanism are exactly those described for the first vertex position, the internal rotation and the external rotation of the head taking place in the opposite directions.

CHAPTER XXII

MANAGEMENT OF LABOUR

THE principles underlying antenatal care and the supervision of the patient in anticipation of her labour have been fully described earlier in this volume (Chapter X). Here we are concerned with the management of a normal labour and more particularly in the patient's home. We cannot discuss the relative advantages of institutional and domiciliary midwifery for normal cases. This, however, we would stress—*it is advisable that the first confinement should be conducted in an institution.* For some time to come large numbers of women will continue to have their confinements at home. It is an interesting fact that careful and efficient management of labour in the homes of all classes of the community gives excellent results, provided the labour runs a normal course and only minor operative procedures are undertaken. In former days the hospital was reserved for destitute and abnormal cases. To-day a large number of women prefer to have their confinement in an institution.

Preparations.—In anticipation of the confinement the woman who elects to have the delivery at home should be instructed to have carefully stored and in readiness two months before the date the articles and drugs that will be required.¹ These are cotton-wool (2 lbs.) and gamgee tissue (2 packets), sanitary sheets (2), macintosh sheets (2), binders (3), clean nightdresses (3), feeding-cup, hot-water bottle, bed-pan, safety-pins, enamel basins and jugs which can be easily sterilised and are unbreakable. The nurse engaged for the case is expected to make these arrangements and, in addition, to see that there is provided a bottle of castor oil and a small sealed bottle of biniodide of mercury tabloids and Dettol (p. 401), methylated spirit (1 pint); also articles necessary for the child—sterilised linen thread and sterile powder for dusting the cord, flannel for infant's binder, etc. It is also the duty of the nurse to have the room arranged, the basins thoroughly sterilised, and a plentiful supply of hot and cold boiled water.

¹ The articles necessary for a confinement are now put up in "drums" sterilised and ready for use, which can be obtained through any firm of surgical instrument makers or druggists. This is undoubtedly a great advance over the old arrangement whereby the patient purchased the articles in an unsterilised condition from the druggist. It is most desirable that the doctor in charge should state specifically the articles he wishes included. Some doctors now include two gowns, two pairs of sterilised gloves, and four masks. Many local authorities supply obstetric outfits of a very simple nature at a small cost or free of charge to necessitous cases. We are strongly opposed, however, to treating necessitous patients in their own homes—the surroundings are so dreadful in most instances that no confinement should be permitted to take place in them unless in case of emergency.

If a midwife is in attendance she is responsible that the aforementioned preparations are carried out as far as circumstances will permit. She should take with her to the case a douche apparatus, an enema syringe, scissors, two nail-brushes, linen thread for the ligatures for the cord, clinical thermometer and charts, bath thermometer, antiseptics, and lotion for the eyes of the child (nitrate of silver, 2 gr. to 1 oz.). We also recommend that she should carry two pairs of sterilised gloves and four sterilised masks.

The medical attendant should possess an obstetric bag with a detachable linen lining, which can be removed periodically for washing and sterilising. The bag should contain an instrument steriliser large enough to hold the obstetric forceps, two nail-brushes, scissors, needles, needle-holder, silkworm sutures and catgut put up in glass tubes, Rotunda douche with vaginal and uterine nozzles. Transfusion apparatus and hypodermic syringe should also be carried. The drugs to be carried are the following: tablets of biniodide or perchloride of mercury, Dettol, liquid extract of ergot, ergometrine, chloroform, opium (laudanum or liquor opii sedativus), hypodermic tablets of digitalin, morphine, strychnine, scopolamine, ampoules of pituitary extract ($\frac{1}{2}$ c.c.), and lotion for the eyes of the child (nitrate of silver, 2 gr. to 1 oz.).

ROOM FOR CONFINEMENT.—The room chosen for the confinement should, if possible, be bright and sunny, be thoroughly cleaned some weeks before the expected date, and all unnecessary furniture and curtains on which dust can gather removed. But this is not feasible in many homes and, fortunately, is not a detail of primary importance.

It is well to satisfy oneself beforehand of the condition of the drains of the house. In former times great importance was attached to this danger. While in no way deprecating the disturbing influence sewer gases may exert they cannot cause puerperal fever in the restricted sense in which the disease is understood to-day—they may, however, cause pyrexia and upset the patient generally.

One of the greatest dangers to the patient confined at home is from the other inmates of the house should they have sore throat, nasopharyngeal catarrh, influenza, scarlet fever, or erysipelas. Special inquiries should be made on this point. Should any such infection exist the patient should be isolated or, better still, removed to an institution.

BED AND FURNISHINGS.—The bed should, where possible, be a single one, not too narrow or too low, with a firm mattress. Should the mattress be soft it may be stiffened by laying a series of boards—*e.g.* the leaves of an expanding table—under it. The bed should be so placed that there can be obtained a good light shining on the patient's buttocks and vaginal outlet. It should be placed free of the walls on either side so that doctor and nurse can readily pass from one side to the other.

Freshly laundered sheets and clean blankets should be used. A large macintosh sheet should be placed next the mattress. Over this a sheet is placed, and over it a small macintosh projecting beyond the near edge of the bed and covered by the draw sheet. In poor-class practice sheets of clean brown paper or newspaper may have to be substituted for the macintosh sheets in an emergency.

As we shall see when considering the sources of puerperal infection (p. 640), bedclothes, bedding, etc., are fortunately only rarely the source of infection, otherwise few parturients delivered at home would escape infection.

The midwife or nurse should see that there is one large and two smaller tables suitably placed in the room on which the necessary articles (basins, etc.) can be placed.

BATH.—When conditions permit of it the patient should have a bath at the onset of labour. If there is a shower equipment it should be used. Failing it, she should kneel in the bath while the nurse washes her with soap and water—the object of this detail is to prevent soiled water entering the vagina.

EVACUATION OF BOWELS.—It is of very great importance that the bowels should be well emptied early in labour. *In the case of the primipara* an adequate dose ($1\frac{1}{2}$ tablespoonfuls) of castor oil flavoured with lemon and a little brandy is undoubtedly the best purgative. After the first movement of the bowels the patient should have two enemata at intervals of an hour. By this means the lower bowel is completely evacuated, and the disagreeable and dangerous occurrence of the bowels moving when the child is being expelled can be prevented. *In a multipara it is best to empty the bowel by enema*, as with her the looser motion produced by castor oil may be held up by the presenting head of the child and come away as the child is being delivered.

VAGINAL DOUCHING.—Douching before or after labour is to be deprecated. Vaginal douching is required before labour if there is a septic vaginal discharge. In such cases the vagina should be very carefully cleansed (p. 283), not simply douched. Following delivery intrauterine douching (p. 566) may be necessary or advisable to control postpartum hæmorrhage, and after any severe internal manipulation, such as removal of placenta or débris of an abortion. Before certain operative procedures, vaginal douching may be advisable (p. 693).

CLOTHING.—The clothing of the patient should consist of singlet, nightgown and stockings. The gown is tucked up under the armpits when the patient goes to bed. All are removed and clean clothing put on after the labour is completed.

DUTIES OF ATTENDANT WHEN SUMMONED.—Whenever he receives intimation that labour has started, the doctor, if he is primarily responsible, should answer the call promptly in case some abnormality of position or presentation of the child, or other complication, which might have been dealt with successfully in the early stages of labour,

may have developed since he last saw his patient. If, however, the skilled midwife is primarily responsible, the doctor is not expected to visit the patient until he is summoned by the midwife.

On arrival the attendant will obtain from the patient information regarding the time when the pains commenced, where they are felt (in the abdomen or in the back), their frequency and intensity, whether there is a red vaginal discharge ("show"), and whether or not the waters have escaped.

If the patient is a multipara and the attendant has not already seen her at an earlier period in pregnancy—and even to-day this not infrequently happens—he should inquire if there was any difficulty during her previous labours. The patient is meanwhile put to bed if she is not already there, and the attendant proceeds to carry out the routine examination detailed in a previous chapter. In similar circumstances, if the patient is a primipara, a more exhaustive examination may be necessary. Circumstances will determine whether or not a vaginal examination is necessary (p. 402).

Antisepsis and Asepsis.—Some 40 per cent. of deaths in this country from conditions directly due to pregnancy and childbirth result from puerperal infection; and of these deaths from infection 20 per cent. follow normal labours. It is now known that most of these fatal infections are caused by organisms reaching the genital tract of the patient from an outside source and through some breach in the antiseptic and aseptic technique of the conduct of labour and the puerperium. In the years before 1935 several investigators showed that a small number of normal pregnant women harboured in the vagina hæmolytic streptococci indistinguishable, by any means then known, from the pathogenic strains causing puerperal fever. Infections in the puerperium due to streptococci were therefore presumed to be endogenous and unavoidable in many cases. In 1935, however, Lancefield and Hare described the serological differentiation of hæmolytic streptococci into nine groups, distinguished by the letters A-K, and showed that severe invasive infections are practically always caused by the streptococci belonging to Group A. In a group of 855 women investigated since this fact was known, not one was found to harbour the Group A streptococcus at the onset of labour, although four subsequently developed an infection due to this organism. Severe invasive infections of the puerperium, therefore, are in the great majority of cases not of endogenous origin or due to streptococci occasionally present in the vagina antenatally, but to organisms introduced into the genital tract from an outside source, generally the upper respiratory tract of the attendants (doctor, midwife, or nurse) or the patient herself. These subjects are discussed more fully under the title of Puerperal Sepsis (Chapter XXXVII, p. 638).

During labour strict surgical cleanliness must govern every move, and a reliable and thorough antiseptic technique practised. The

obstetrician or nurse must as far as possible avoid coming into contact with infectious cases, especially those known to be caused by the hæmolytic streptococcus. Recent contact with such cases should necessitate a bath and change of clothing, and, ideally, a bacteriological examination of the upper respiratory tract before attendance on a woman in labour. Since it is known that pathogenic streptococci may be harboured unawares in the nose and throat, an adequate mask should be worn over mouth and nose by the attendant whenever the vulva is uncovered during labour and the puerperium. *Even if these precautions are taken it is most undesirable that a doctor, midwife, or nurse suffering from an acute or chronic infection of the upper respiratory tract should attend a parturient.*

Employment of sterilised gowns, gloves, masks, sheets, dressings, instruments, etc., contributes to the aseptic management of labour; for the rest *antisepsis* must be relied upon. *Asepsis* does not provide the maximum protection against infection even in maternity hospitals.

CLEANSING OF VULVA.—We have already referred to the bath before labour. A word or two now regarding the cleansing of the vulva and maintaining it cleansed. Surgeons attach great importance to the preparation of what they term the “field of operation.” Obstetricians do so also; but their field of operation—vulva, perineum, pubes, inside of thighs—is much more difficult to maintain in a condition approaching surgical cleanliness. The vulvar hair should be shaved. The genitals, perineum, pubes and inside of thighs should be well washed with soap and water and then with methylated spirit and dried. It should then be smeared with Dettol cream (30 per cent.). Skin so treated remains bactericidally active for several hours, giving persisting antiseptic protection. A watery solution of iodine (2 per cent.) is even more efficient than Dettol in this property, but the staining, the smell and individual susceptibility to its toxic effects make it undesirable for use in labour in many instances. With lysol, perchloride, picric acid, mercurochrome and other antiseptics in dilutions tolerated by the skin, the period of protection may be less than an hour.

During labour pledgets of wool (not too small) soaked in 2 per cent. Dettol solution may be used to wipe away discharges. Biniodide of mercury (watery solution, 1 in 500) is not quite so good. The pledgets should be drawn once only from before backwards to avoid the bringing forwards of infection from the anus. If Dettol cream has been applied, swabbing weakens protection by the cream.

Before any vaginal examination or other manipulation is made the vulva and the inside of the thighs should be cleansed as detailed above. The labia should be held apart in introducing the fingers.

*The patient must be warned not to touch the genitals with her hands—*some patients are prone to do so, especially if the pains are very

severe. The danger is particularly serious if she has any infection of the upper respiratory tract. In such circumstances her hands may become heavily infected with the worst strain of streptococci. The conveyance of organisms may be avoided by smearing her hands with Dettol during the labour, as already described.

Attention to the details just given offers a lasting chemical barrier against infection of the genital tract during labour by attendants or by the patient herself. It is cause for satisfaction that each one can be carried out in the patient's home, and even if the home is a very humble one.

CLEANSING OF ATTENDANTS' HANDS.—The cleansing before a vaginal examination must be carried out as scrupulously as for a surgical operation. They should be scrubbed for two minutes in warm water, using yellow soap and a boiled nail-brush for the nails and nail-folds. A teaspoonful of "neat" Dettol or 30 per cent. cream should be poured into the palm of the hand and worked into the skin until dry. The wearing of sterilised rubber gloves increases the margin of safety for the patient. Gloves possess the further advantage that after contact with discharges they can be easily and quickly re-sterilised on the hands by washing in soap and water and soaking for two minutes in a solution of Dettol or iodine (2 per cent.); or solution of biniodide (1 in 500) of mercury in spirit. A basin containing 2 per cent. Dettol or 1 in 500 biniodide of mercury lotion should be kept at the patient's bedside so that the gloved hands can be repeatedly rinsed during the delivery.

MASKS.—We have already indicated the advisability of the wearing of sterilised masks by doctors, midwives, and nurses attending a confinement; but only if they are used correctly.

VAGINAL EXAMINATION.—Vaginal examinations should be as infrequent as possible—even if the greatest care is exercised every vaginal examination is a possible source of danger. Many obstetric specialists make no vaginal examination during labour in cases which they have carefully investigated beforehand and have found to be normal. The position of the head is determined by abdominal palpation, while any deformity of the pelvis has been determined before labour. Prolapse of the cord is almost the only complication which may unexpectedly arise—this complication very seldom occurs in a normal position of the vertex (p. 499). In most labours which run a normal course one vaginal examination (or at most two) is all that is necessary.

RECTAL EXAMINATION.—In recent years in some clinics in this country, and in many abroad, rectal examination has been substituted for vaginal examination. The disadvantage of a rectal examination is that some abnormalities are not so easily recognised, but with practice this can be almost completely overcome. If a long series of cases is taken, the morbidity rate (pyrexia) is slightly lower in cases in which

rectal examination is employed ; but the difference is very slight if every precaution is taken to limit vaginal examinations and to employ the strictest antiseptic technique prior to making the examination.

NOTING THE PROGRESS OF LABOUR.—To-day the progress of labour is followed from the abdomen by noting the descent of head, of anterior shoulder and of foetal heart sounds—the accompanying figure (Fig. 139) is self-explanatory.

Should at any time an internal examination be deemed necessary the patient is asked to turn on her side, a finger-stall is pulled over the index finger, and a *rectal* examination is made. *This is the simplest and safest manner of following the course of a labour in respect to descent of head.*

MANAGEMENT OF THE FIRST STAGE

During this stage the patient should have simple fluid *nourishment*. *It should be specially rich in sugar and starches* in order to combat the tendency to acidosis. Boiling water, lemon or orange drinks and glucose may be given with advantage. The *bowels* should be emptied early, as already described (p. 399). The perineum should be sponged by an antiseptic lotion from time to time and always after any movement of the bowels. It is most important also that the patient should empty her *bladder* frequently—overdistension of the bladder inhibits uterine action.

During this stage the patient should be encouraged to move about the room. From time to time she should rest in bed. *All bearing-down efforts should be discouraged* as they serve no purpose and only exhaust the patient. She should be encouraged to occupy herself in any manner which will help to distract her attention in the intervals of the pains.

This raises the very important question of the mental attitude of the patient towards labour. If she has been wisely advised during pregnancy by her doctor or midwife ; or, on the other hand, if she has had no advice whatsoever, as was customary in times past, she will not have undue concern regarding her labour. Unfortunately, however, since the subject has been so freely written about and discussed, many women have become “rattled” and contemplate labour with concern and even fear. A degree of concern is natural and cannot be entirely eliminated, but probably is of no great consequence. Anything approaching fear, however, exercises three deleterious influences : (a) It inhibits uterine action ; (b) it causes the patient to request and even demand sedatives and analgesics early in labour ; (c) it favours the condition of shock (p. 571).

We would place in the forefront, therefore, the importance of encouragement, or, to use a colloquial expression, “bucking up” of the patient. Only a few patients in our experience fail to respond. Undue cheerfulness on the part of doctor and midwife only annoys

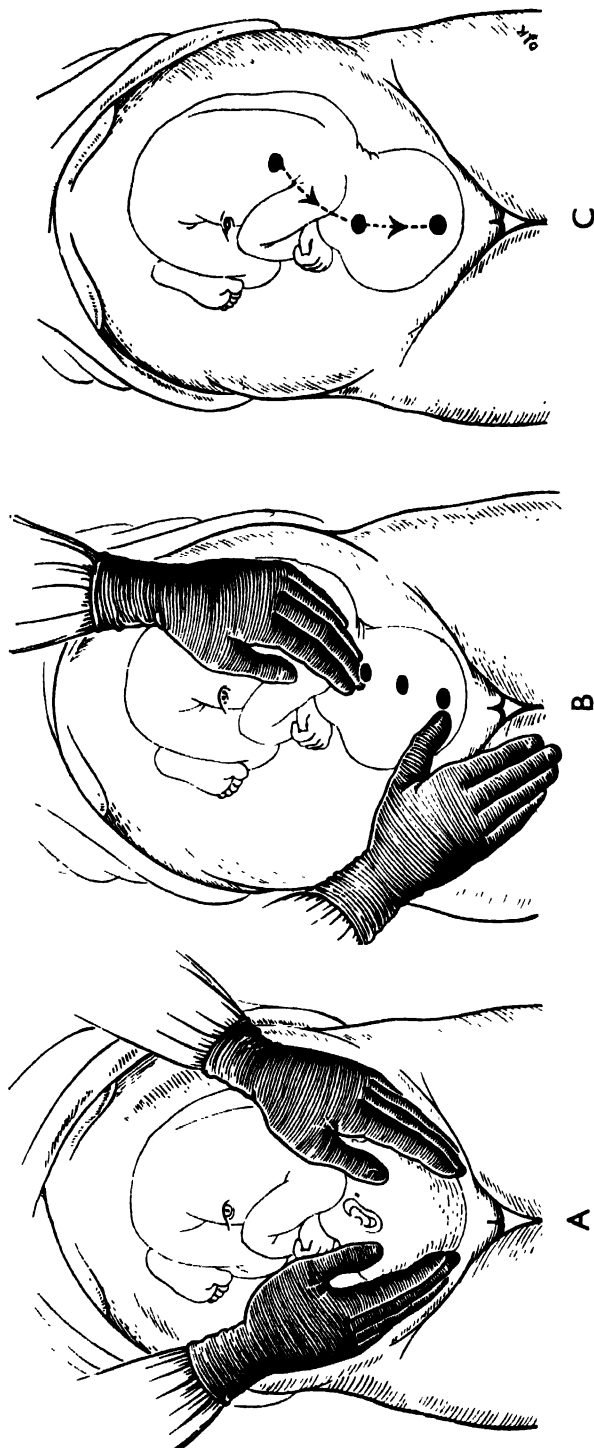


FIG. 139.—Simple Means employed for noting the Progress of a Normal Labour.
A. Palpation of head as it descends into pelvis. B. Determining descent of shoulder.
C. Descent of area of maximum intensity of foetal heart sounds.

the patient, but an appeal to her fortitude seldom fails, unless it has been undermined beforehand by a foolish mother, friends, nurse, or doctor.

If "twilight sleep" is to be employed it will usually be commenced during the first stage under conditions to be referred to later. The indications for the employment of sedatives and analgesics in the first stage will be discussed in the following chapter.

MANAGEMENT OF THE SECOND STAGE

During the second stage the patient, if a multipara, should remain in bed. If, however, she is a primipara there is no risk in permitting her to be out of bed (provided she is not having any sedatives), until the head is bulging the perineum. There is much to be said in favour of the "squatting" posture favoured by primitive peoples. This posture, however, is impossible if the patient is given any form of sedative.

If the membranes do not rupture when the os is fully dilated, they should be ruptured by means of a sterile probe or the point of scissors. Many teachers recommend a vaginal examination after the rupture of the membranes so that the attendant can assure himself that the presentation and position are satisfactory, and that the cord has not prolapsed through the cervix with the gush of the waters. The pros and cons for this particular examination have been referred to earlier in this chapter.

The vulva should be sponged from time to time with sterile swabs soaked in antiseptic lotion, as described.

The patient should now be encouraged to bear down with each pain whenever she feels inclined to do so (p. 374). To enable her better to do this a strong towel should be tied round the head of the bed in such a position that she can easily seize and pull on it as she lies on her side. If, however, she is lying on her back, a rigid support at the foot of the bed against which she can press her feet is the best device for aiding expulsive efforts.

The foetal heart should be auscultated every half-hour and at the same time the attendant may by means of abdominal palpation, or by rectal examination, satisfy himself that the head is safely passing downwards through the pelvic cavity. The pulse and temperature of the patient should be observed at intervals. No attempt, however, should be made to hasten the delivery by instrumental means unless there is distinct cause for anxiety either on account of the condition of the mother, or of the child as judged by the rate of the foetal heart (*vide Forceps Delivery at Outlet*, p. 705).

The choice and employment of analgesics and anaesthetics in the second stage are discussed a few pages later (p. 413).

The attendant doctor or midwife must watch for the first evidence

of bulging of the perineum by the descending head ; and thereafter for escape of fæcal matter from the anus, forced out by the head. This must be carefully removed by swabs. On each occasion of the escape of the bowel contents the vulva and perineum must be cleansed carefully. It has been already pointed out how the efficient nurse sees to it that the bowels are well emptied early in labour ; but it is often impossible to prevent the escape of some residual fæcal matter.

In this country delivery is generally carried out in the left lateral position, and the escaping head is controlled by the left hand, which is passed between the patient's thighs (Fig. 140). In practically every other country delivery is carried out in the dorsal position, and in many respects this is preferable. Nevertheless, we recommend the left

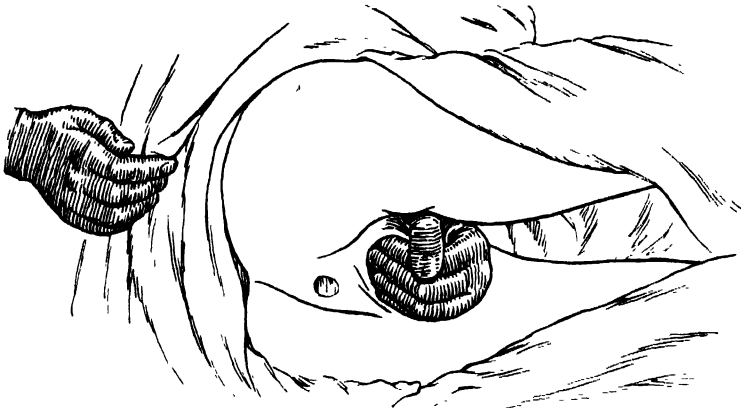


FIG. 140.—Management of Perineum, Left Lateral Position (British method).

It will be observed that the perineum is not touched. The accoucheur holds the occiput in the palm of his hand and prevents it from catching at the symphysis. The fingers are seen pressing the sacrum upwards. By these means flexion of the head is maintained, and the head can only escape slowly through the vaginal outlet.

lateral position because it possesses two great advantages : (a) It enables the accoucheur to control the exit of the head better, if the patient is restless ; (b) the vulva is more easily kept cleansed and uncontaminated by fæcal matter.

The essentials to attend to are that by means of the left hand the accoucheur prevents the head from catching against the symphysis pubis whilst at the same time he keeps the head so tilted as to keep the occiput well down. In this way flexion is maintained so that the head is constrained to escape *with its short suboccipito-bregmatic circumference passing through the vulvar orifice* ; and furthermore that it escapes slowly.

It is often helpful to deliver the head between two pains—*i.e.*, whilst the perineum and the orifice are relaxed—for during a pain there is always a certain amount of contraction of the muscles of the pelvic floor and the outlet, and this tends to make the perineum more rigid and therefore more liable to tear. To deliver between the pains the

time chosen is when the distension of the perineum has reached the stage when the head is nearly born ("crowning") and when its birth

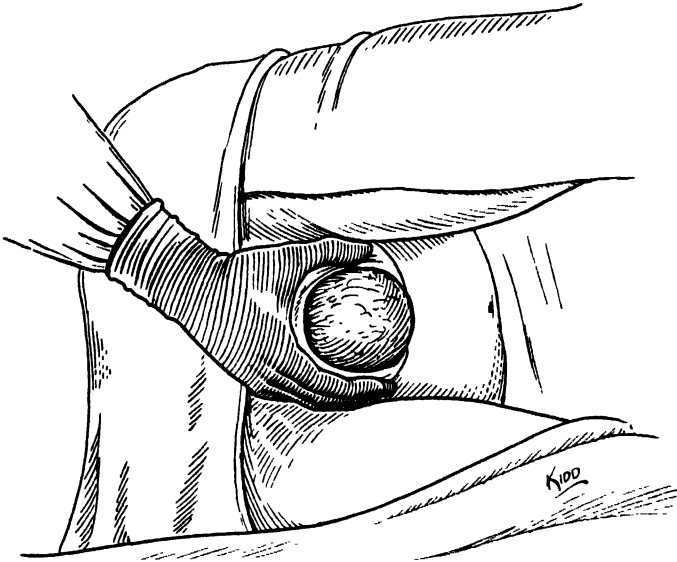


FIG. 141.—Swab over Anus not shown ; hand controlling exit of head.
Alternative method to one figured on previous page.

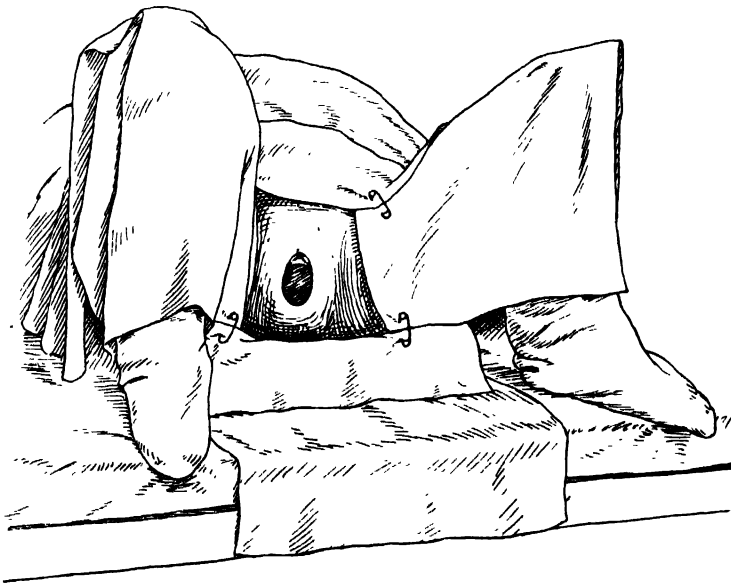


FIG. 142.—Patient in Dorsal position prepared for delivery.

would actually take place, except for the restraining influence of the accoucheur's left hand. To effect delivery a sterile pad is placed over

the perineum and the dilated anal orifice. Between the thumb and fingers of the right hand the accoucheur grips the sinciput of the head where it is seen bulging the perineum just in front of the coccyx—holding it in position till the pain subsides. The accoucheur now presses the head slowly through the vulvar orifice.

Prevention of perineal laceration can best be secured by (a) maintaining flexion of the head, (b) allowing the head to escape slowly; and we are of the opinion, as already stated, that such manipulation can best be carried out with the patient in the lateral position. Where, especially in a primipara, the perineum is so rigid that it is seriously delaying the delivery of the child or, where it is becoming clear to the attendant that a laceration is unavoidable, *episiotomy* is called for. This consists of a lateral incision of the lower end of the postero-lateral vaginal wall (p. 540).

When the head is born the attendant should thoroughly rinse his gloved hands in antiseptic lotion. Following this he should pass his fingers up to feel if a loop of the cord is round the child's neck. If so the loop of cord is drawn down and slipped over the occiput towards the ventral aspect of the child; or the child's trunk is allowed to slip through the loop. Sometimes the loop is so tightly round the neck that neither of these procedures is possible; in such a case the cord should be divided between two pairs of pressure forceps and the child delivered.

The delivery of the shoulders demands special attention. Only very moderate traction on the delivered head is permissible (p. 616). If patience is exercised and the uterus is stimulated to contract by kneading it, the shoulders will descend and rotate. They should be compelled to escape slowly, as otherwise they may cause or enlarge a perineal tear. The body quickly follows the shoulders.

It is most important that a hand should be placed on and follow the fundus of the uterus downwards as the child is expelled. If the attendant is single-handed he or she may do this with the left hand. If both a doctor and midwife or nurse are in attendance, the nurse should undertake this detail.

Immediately following the birth of the child the patient should be turned round on to her back as on the side there is a risk of suction of discharges and air into the uterus, and thence into the gaping uterine sinuses. The most rare occurrence of an air embolism takes place at this stage (p. 570).

Immediately the child is born and before the cord is ligated, the eyes are washed with sterile water, and in all hospital cases and in suspicious cases in private, a few drops of nitrate of silver solution (1 per cent.) are dropped in—as a prophylactic measure against ophthalmia neonatorum (p. 624).

The cord is then tied in two places with a two or three ply of strong twisted sterile thread or silk. The first ligature is placed 1 inch from

the umbilicus. The second is placed close up to the vulvar orifice, after the cord has been pulled gently from the vagina to put it slightly on the stretch—this ligature serves as an index to mark the descent of the placenta in the third stage (Fig. 143). The cord is then divided on the distal side of the first ligature placed near the umbilicus.

The child's air passages are now cleared (p. 620) if it has not already cried lustily. The child's condition being satisfactory, it is wrapped in warm flannel or a towel and taken charge of by the nurse. Before she proceeds to bath the baby she should satisfy herself that there is no blood leaking from the cord.

At this stage of labour the *perineum should be inspected* for any laceration. In the great majority of primipara there is slight tearing of the perineum, often of little more than the fourchette. If a laceration has occurred, but is only slight, the necessary stitching—deep silkworm gut sutures through the whole thickness of the perineum—may be conveniently done at the end of the second stage, whilst the attendant is awaiting the birth of the placenta. In this way advantage is taken of the general anæsthetic, if this has been administered during the last stages of labour. After the introduction of the sutures the third stage may be carried out without the need of continued anæsthesia. In the event of the laceration being extensive and involving the bowel, the stitching should be delayed until the third stage is completed. Repair of perineal tears is fully described elsewhere (p. 595).

It is extremely important that every laceration of the perineum, no matter how small, be cleanly united. Inattention to this point may be followed by infection. The risks of infection are greater in perineal lacerations or in those in the lower vagina than in tears at a higher level, because of the immediate proximity of the bowel. Furthermore, some of the worst cases of puerperal septicæmia are due to the entry of infection through a perineal tear by droplet or spray contamination (p. 640).

Apart from the risks of infection, lacerations of the pelvic floor and vagina are apt to be followed at a later date by prolapse of the vaginal walls and uterus (p. 843), severe lacerations and infection of cervix, by hypertrophy of cervix (p. 907), while there is undoubted proof that unrepaired cervical tears predispose to cancer of cervix (p. 772). The great majority of the disabilities and minor ailments that the gynæcologist is afterwards called upon to treat are due to the faulty management of labour and failure to repair injuries.

In all primiparæ the cervix is lacerated; but very rarely indeed is it of serious consequence in a normal labour. Extensive lacerations are produced most commonly by forcibly dragging the child through an undulated os (p. 596).

MANAGEMENT OF THE THIRD STAGE

The important object is to conduct this stage so that no portion of placenta or membranes is retained. The most common error is to hurry this stage unduly.

The attendant sits at the patient's bedside, placing his left hand on the fundus of the uterus. Left to nature the uterus rests for a few minutes (ten to fifteen) after the birth of the child ; then it begins to

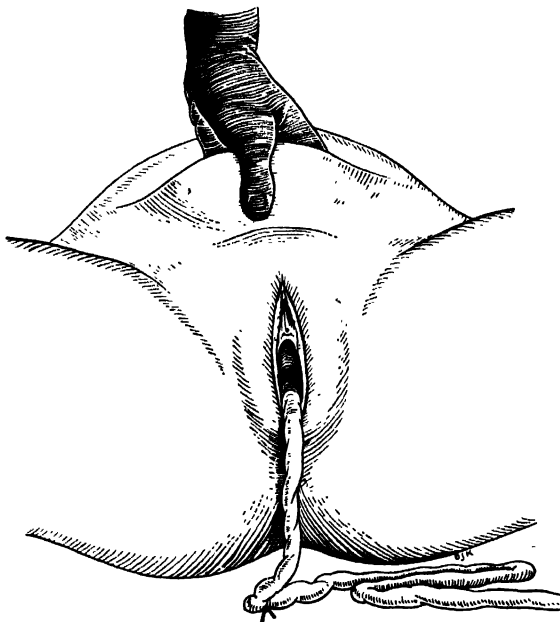


FIG. 143.—Expressing Placenta.

The cord, as indicated by the knotted ligature, has slipped well down ; the uterus has been massaged into a condition of contraction ; the accoucheur is compressing the fundus between his thumb and fingers.

contract from time to time. It is during these contractions that separation of placenta takes place (*vide* p. 379). *The uterus should not be massaged or kneaded, nor should premature attempts be made to express the placenta, for both tend to produce retention of the placenta and/or membranes.*

This waiting period may be utilised for the repair of minor perineal lacerations, as already indicated.

When the placenta has slipped into the lower uterine segment—this usually occurs in from twenty to thirty minutes—it may safely be expressed. *The passage of the placenta into the lower segment is indicated :* (1) by the alteration in shape and height of the uterus—it becomes wider below and narrower above ; (2) by the fact that more of the cord is seen to slip out of the vagina.

Whenever the placenta has slipped into the lower segment the abdominal hand should knead the uterus to establish a strong uterine contraction. After a good contraction is established (but not until then) the fundus is grasped antero-posteriorly between the thumb and fingers and compressed and pushed downwards and backwards to express the placenta (Credé method) (Fig. 143). As the placenta escapes it is grasped by the other hand and allowed to slip out slowly, dragging the membranes after it. The delivery of the placenta must be made carefully, as otherwise the membranes may be torn. When they are felt to be held back and do not escape freely, the placenta should be rotated by the two hands so that the membranes

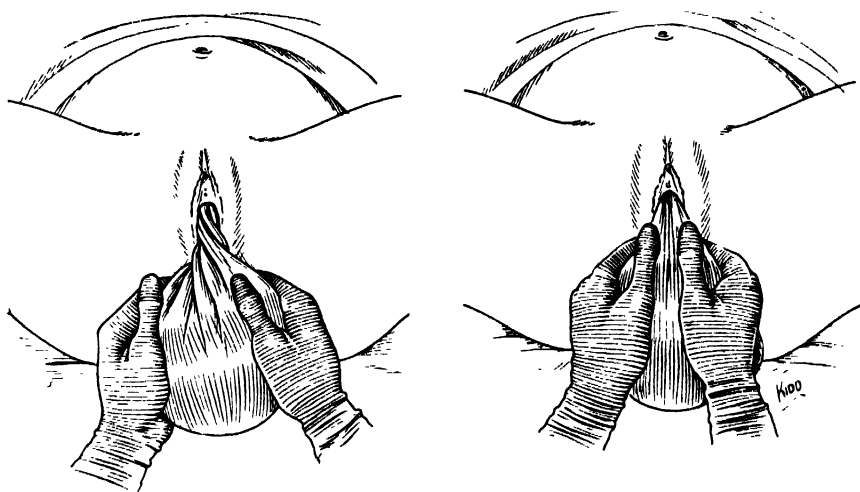


FIG. 144.—Alternative methods for removing Placenta and Membranes.
In left-hand figure the placenta is being rotated, in order to twist membranes into a cord,
but in right-hand figure no rotation is being employed.

are twisted into the form of a rope (Fig. 144). This, combined with slow gentle traction, usually effects their complete delivery.

The placenta and *membranes* are then floated out in water and a careful examination made to ensure that they are complete.

The *uterus* is now firmly massaged and ergot or pituitary extract is given. The patient is then carefully sponged with an antiseptic lotion, and any suturing that requires to be done is carried out, unless this has been done before the birth of the placenta. An aseptic pad is then placed over the vulva and the abdominal binder is applied. No abdominal pad should be placed under the binder. No douche should be given unless there is postpartum hæmorrhage or unless the hand has been introduced into the uterus. The patient should be covered with warm blankets and, if she feels chilled, one or more hot-water bottles should be placed in the bed.

The *temperature* should be taken shortly after delivery. But much

more important is it to *take the pulse-rate at intervals*. Any rapidity of pulse should at once arrest attention. It almost invariably indicates intrauterine bleeding often of a quiet and insidious nature (p. 560). In such circumstances the binder should be loosened and the vaginal pad removed. The uterus should then be massaged and compressed as described for delivery of placenta. This will generally result in a considerable amount of blood and blood-clot being expelled from the vagina—the condition, in other words, is one of postpartum hæmorrhage, fully considered elsewhere (p. 559). Should little blood and blood-clot come away, one should consider the possibility of “obstetric shock.” Further massage of the uterus is in this event contraindicated—absolute rest, stimulants, and, if need be, rectal saline infusion are indicated (p. 571).

The attendant must never leave the patient until he is satisfied (1) that the uterus is well retracted, (2) that the pulse is satisfactory, (3) that there is not an undue amount of bleeding. He should give instructions that the patient is to be given a teaspoonful of liquid extract of ergot if the vaginal discharge is excessive.

The features and management of the puerperium are described elsewhere (pp. 631-637).

The dressing of the umbilical cord and prevention of infection of the stump of the cord are referred to elsewhere (p. 627).

CHAPTER XXIII

ANÆSTHETICS, ANALGESICS AND SEDATIVES IN OBSTETRICS

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A. ANÆSTHETICS AND ANALGESICS IN LABOUR

IT is the duty of the obstetric attendant to relieve the pangs of labour in so far as this can be done with safety to mother and child. We propose to discuss the various drugs in common use to-day and to indicate the advantages and limitations of each one. In a later section we give a short summary of what in our opinion is the ideal manner in which they should be employed in a normal labour.

Chloroform.—When administered in small and intermittent quantities, chloroform can be continued over a considerable period with comparative safety. Employed in this way it was first introduced into obstetrics by Sir James Young Simpson, and, as it was thus administered to Queen Victoria, this method of chloroform analgesia is often described as “à la Reine.” It is easy of application by means of the Christie Brown or the Young Simpson inhaler, and it is well adapted for domestic as for hospital practice. So used, the anæsthetic does not completely abolish sensation, and the patient cries out or groans with each pain, but there is usually a complete obliteration of the subsequent memory of the pains. When given with skill in this way during the second stage, with a deeper anæsthesia at the time of the actual delivery, chloroform is comparatively safe. There are many practitioners who have used chloroform for normal midwifery throughout many years of practice without any mishap.

At the same time we have to admit that chloroform can never be regarded as completely free from disadvantages or even dangers. It is known that it tends to decrease the strength of, and to increase the intervals between, the pains and thus to delay labour and predispose to post-partum hæmorrhage and retention of the placenta and membranes, although in the majority of cases this consideration is not to be seriously weighed against the relief accorded to the patient. A much more serious question, however, is found in the real risk to life which it introduces. It would seem that there are some women who are peculiarly liable to suffer from the toxic effects of this drug. Indeed,

it is generally agreed that chloroform is definitely contraindicated in women suffering from toxæmia in any of its forms. There also do occur fatalities in the shape of sudden syncope or death from post-anæsthetic broncho-pneumonia, or acute toxic damage of the liver when the drug had apparently been administered with skill and care.

We have further to keep before our minds the fact that the circumstances surrounding domestic midwifery often imply that anæsthesia is carried out under difficulties which must add to its risks. It has been repeatedly pointed out that many of the deaths from so-called "obstetric shock" or "heart failure" may in reality have probably arisen from the anæsthetic.

Particularly dangerous is repeat anæsthesia with chloroform.

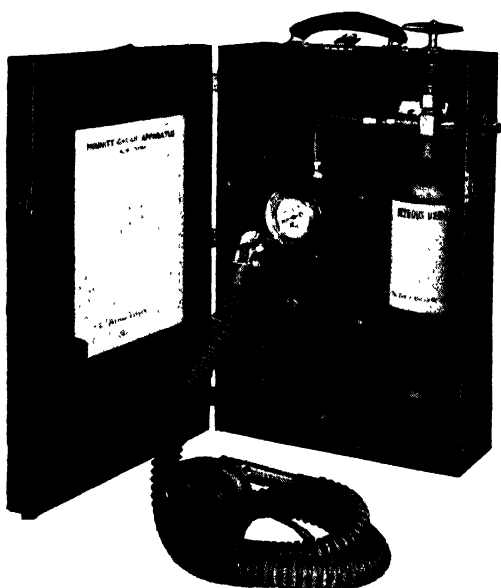


FIG. 145.—Walton-Minnitt Gas-Air Analgesia Apparatus. (Portable model.)

A woman who has had a long-continued chloroform analgesia or who has had more than a short chloroform anæsthesia is peculiarly liable to suffer from chloroform poisoning if after an interval a new anæsthesia with the same drug is given. Many women who have had chloroform for a "failed forceps" die from this cause.

Ether is generally contraindicated in obstetric practice because of the special risk to which pregnant women are exposed of bronchial irritation leading to bronchitis and broncho-pneumonia. Gwathmey in America has strongly ad-

vocated ether given per rectum (mixture contains quinine, alcohol, ether in olive oil). This method has not been widely employed in this country.

Nitrous oxide and oxygen is the safest and most satisfactory form of analgesia when available. The small obstetric model of the McKesson intermittent flow gas-oxygen machine has been specially designed for this purpose. A nitrous oxide-oxygen mixture has no harmful effects on mother or child, and does not delay labour. In the early stages it is given intermittently, a 10 to 15 per cent. mixture being administered with the onset of each pain, and discontinued when the pain stops. Towards the end of the second stage continuous anæsthesia is induced.

Under present conditions it is seldom possible to secure the services

of a skilled anæsthetist for this form of analgesia. To overcome this difficulty, a simple apparatus, for the administration of a nitrous oxide-air mixture, suitable for use by specially trained midwives, has recently been evolved.

Nitrous Oxide-Air.—As the result of an investigation carried out by a committee of the Royal College of Obstetricians and Gynæcologists, it was recommended that the only form of analgesia suitable for administration during labour by midwives, specially trained for the purpose, was that produced by nitrous oxide and air, delivered automatically by approved machines. The original machine, designed by Minnitt of Liverpool, delivers a mixture containing 45 per cent. nitrous oxide. The patient applies the mask to her face just before the onset of a pain, places her finger over an air hole, or presses a button, according to the type of apparatus, and inhales and exhales normally. The machine delivers the nitrous oxide-air mixture which in about 90 per cent. of cases will produce satisfactory analgesia. When the pain is over the patient removes the mask, and reapplies it with the onset of the next pain. Similar machines approved by the C.M.B. as being suitable for use by midwives are the Walton-Minnitt (Figs. 145 and 146), the Queen Charlotte and the Autogesia Gas-Air apparatus. There is sometimes some delay at the beginning of each pain in the onset of analgesia, and to overcome this difficulty Moir has designed an apparatus that delivers two to three breaths of nitrous oxide at the beginning of each pain. This empties the gas bag, which takes one minute to refill. During this period the patient can only obtain air, so the risk of overdosage is eliminated. The Wellhouse machine designed by Elam is an improvement on this apparatus, which does not always provide a sufficiently long analgesia. Elam's machine delivers one breath of pure nitrous oxide at the beginning of each cycle and thereafter a nitrous oxide-air mixture.

It should be realised that these machines are not designed to produce anæsthesia, and should this become necessary, nitrous oxide-oxygen or some other anæsthetic must be substituted for the gas and air analgesia.

Trichlorethylene is a non-inflammable liquid anæsthetic still on trial. When its vapour is inhaled from a cheap and simple apparatus, designed by Marrett, satisfactory analgesia is induced. Results to date suggest that it may be of value for the production of analgesia in labour.

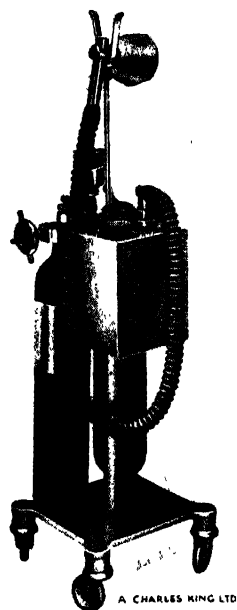


FIG. 146.—Walton - Minnitt Gas-Air Analgesia Apparatus. (Hospital model.)

B. SEDATIVES AND NARCOTICS

Chloral and Bromide.—Chloral (20 gr.) and potassium or sodium bromide (30 gr.) in combination are of great value in the early stages of labour and until the bearing-down pains of the second stage commence. The mixture may be repeated at two-hourly intervals. The advantage of using such drugs consists in the fact that they are safe, and may be sufficient in themselves during a considerable period of the labour. In the second place, if and when stronger drugs become necessary, these can be employed in smaller doses than would otherwise be the case.

Morphia.—This is one of the most useful drugs in obstetric practice. Apart from the fact that, if administered towards the end of labour, the child may at birth be found to be “morphinised” and to suffer from an alarming apnoea, morphia in a dosage of $\frac{1}{6}$ to $\frac{1}{4}$ grain may be considered as a safe drug in midwifery. Whilst the foetal apnoea rarely results in death, it is unwise to administer morphia within three or four hours of the expected termination of labour. For nervous primigravidae, with a long premonitory phase and sleep disturbed by pains, the drug is invaluable. So, when exhaustion of the patient is associated with a lagging and enfeeblement of uterine pain (primary inertia), *in the first stage*, morphia, by ensuring sleep, acts as a restorative. In such cases, of course, any factor making for obstruction to the labour must first be excluded.

Scopolamine-Morphine (“Twilight Sleep”) is extensively employed in midwifery. A disadvantage of the method is that a child born after a labour so conducted is often apnoeic, and it may be some considerable time before normal breathing is established. Scopolamine-morphine narcosis is especially useful in cases of long labour, and it is for this reason most valuable in primiparae. For its successful administration it is of paramount importance that the patient be kept completely quiet, and before its commencement the bowels and bladder evacuated to avoid any subsequent disturbance of the patient. The room should be darkened.

The best time to commence the administration is in the first stage, whenever labour is firmly established. A common and convenient mode of administration commences with $\frac{1}{100}$ grain scopolamine (hyoscine hydrobromide) and $\frac{1}{6}$ grain morphine introduced subcutaneously into the leg or arm. The drug after a quarter of an hour or so induces a somnolence from which the patient is partly wakened by each succeeding pain. If properly administered, the patient should have no subsequent memory of the pains.

The effect of the first dose gradually wears off, and at the end of an hour or so a second injection is given, this time the hyoscine alone in a dose of $\frac{1}{100}$ grain. Thereafter, similar doses of hyoscine are repeated as required. In the case of a very long labour a second dose of morphine

in combination with the hyoscine may be given later. As, however, the apnœa, from which the child is apt to suffer, is caused more especially by the morphine, this should not be given when delivery is expected within three or four hours.

Scopolamine morphine narcosis delays labour only to a slight extent and not at all in some instances. During the last phase, if the pains are very strong, chloroform, gas and oxygen or gas and air may be required. A general or local anæsthetic is necessary for the application of forceps or a difficult extraction of the breech.

In some women scopolamine, instead of inducing narcosis, causes excitation and even temporary mania, and in such patients its use must be at once discontinued. During the course of labour carried out under scopolamine and morphine, the patient should be kept under careful observation. The bladder reflex is apt to be abolished and in such cases overdistension of the organ may impede labour. Further, the patient is apt to suffer from severe thirst, which should be satisfied by the administration of sweetened weak tea, lemonade or orangeade. Unless closely supervised she may attempt to slake her thirst by drinking any fluids at her hand.

Nembutal.—This drug has been used extensively in obstetrics, both alone and in combination with other drugs. When used with chloral, nembutal (3 gr.) is followed in ten minutes by chloral hydrate (30 gr.). These doses are repeated in two to three hours, and smaller doses given subsequently as indicated. A maximum of nembutal $7\frac{1}{2}$ grains and chloral 120 grains should not be exceeded in twelve hours. To produce a more rapid and certain result nembutal may be injected intravenously. It is injected slowly at a rate of about 1 c.c. of a 5 per cent. solution per minute, and the injection stopped as soon as the patient loses consciousness. It should be noted that it is dangerous to give a barbiturate by mouth and intravenously to the same patient.

Sodium Amytal (3 to 6 gr. and repeated as indicated) and **Sodium Soneryl** (6 to 11 gr. (3 to 5 capsules) and repeated as indicated) are often employed in obstetrics.

Pernocton has enjoyed a wide popularity on the Continent for many years. The usual dose is 3 c.c. of a 10 per cent. solution given intravenously. At least four minutes should be taken to complete the injection.

Paraldehyde.—This drug given by the rectum has its advocates. Some observers, however, have published data indicating that it tends to delay labour and to cause serious foetal apnœa. Further, its action is too uncertain to recommend it as a routine for the production of analgesia.

Avertin (Bromethol), also employed by the rectal route, has been recommended as a useful and safe drug for obstetrical anæsthesia. The dosage for this purpose is 0.075 gram per kilo body-weight, given

when the os is half dilated in a primipara and two-thirds dilated in a multipara. There is some evidence that labour is prolonged, and the drug produces respiratory depression in the child. This drug is of greater value as a basic narcotic before gynæcological and surgical operations in a dosage of 0.08 to 0.1 gram per kilogram body-weight.

SUMMARY

When labour starts the patient should be encouraged to move about the room; to distract her attention by any suitable means from her discomforts and suffering; and to do without sedatives until she states that the pains are almost more than she can bear. By this means many patients can be piloted through the greater part of the first stage and not a few through the greater part of the second stage without suffering unduly. In fact, if a suitable appeal is made, many women take a pride in displaying fortitude. Unfortunately, women are being "rattled" by a number of their well-intentioned sisters who exaggerate the dangers of parturition and by a number of practitioners, obstetric specialists in particular, who "fuss" their patients by indicating the possibilities of complications instead of shouldering all responsibility, saying little, and encouraging mental robustness and physical courage in their patients.

When it is agreed between doctor and patient that sedatives are necessary or advisable, the patient should be made comfortable in bed, and one of the following procedures adopted:—

(a) If the labour is likely to be prolonged beyond, say, twenty hours, begin with chloral and bromide. Should these drugs prove insufficient, give morphine and scopolamine in small doses— $\frac{1}{4}$ grain morphine and $\frac{1}{100}$ grain scopolamine. Repeat the scopolamine in dosage of $\frac{1}{100}$ grain at intervals of one to two hours during the first stage. In the second stage, if analgesia from these drugs is not sufficient, give "gas and oxygen," "gas and air" or chloroform "à la Reine" during the pains, as already described.

(b) If the labour is likely to be rapid, say ten to fifteen hours, give morphia ($\frac{1}{4}$ gr.) and a full dose of scopolamine ($\frac{1}{100}$ gr.) Repeat scopolamine in dosage of $\frac{1}{100}$ grain in one or two hours if necessary; but give no more morphia. In second stage analgesia may be induced by the methods already mentioned.

(c) When the services of the necessary personnel can be secured, analgesia will be most satisfactory when gas and oxygen or gas and air is given intermittently during the second stage. A small dose of morphia ($\frac{1}{4}$ gr.) may be given early in labour, and the analgesia begun as soon as the pains become uncomfortable. Even should it become necessary to administer chloroform for the final stages of the labour, the chief objection to its use for this purpose will not be present (see p. 413).

Nitrous oxide-oxygen is safer than either chloroform or ether when administered with skill, but the cumbersome apparatus required makes it ill-adapted for domestic midwifery unless an expert anaesthetist is engaged for the labour. As a routine anaesthetic for hospital, "gas and oxygen" is of the greatest value. It is safe in toxæmic cases in which chloroform and ether are contraindicated.

From what we have said it is apparent that the employment of chloroform or gas and oxygen during labour demands judgment and skill. Their use should be restricted to a limited period, and, for this reason, they should not be commenced during the first stage. They are most advantageously given when the severe bearing-down second-stage pains have set in, and during the birth of the head they should be pushed to the verge of a full surgical anaesthesia.

It is necessary to emphasise these matters because the novice may easily be inclined, through a natural desire to assuage the pangs of labour, to begin the administration at too early a stage. Once he is so committed he may be pledged to the carrying out of a long-continued and dangerous anaesthesia, or, as an alternative, to the untimely recourse to instrumental interference. The unwary obstetrician may in this way easily find himself on the horns of a serious dilemma.

A further matter of importance is that the anaesthetic should not be entrusted to any save those who possess the necessary skill and experience. It may be laid down that whenever the medical attendant is required to carry out any obstetric manipulation, such as forceps extraction, there should be available an assistant capable of carrying out the anaesthesia. It is impossible for a doctor to carry out any such procedure with the due regard for asepsis and the undivided attention the administering of an anaesthetic demands. It is true that under the circumstances which obtain so often in present-day obstetric practice an additional qualified practitioner is frequently economically impossible, or in sparsely populated areas difficult to secure. This condition of affairs will prevail until we have succeeded in reorganising the maternity service of the country on sound lines.

How far a midwife should be entrusted with the administration of a general anaesthetic under the superintendence of the doctor is a matter which has often been discussed. It is common knowledge that this practice obtains frequently at the present day, and there are many midwives who, by experience, have acquired considerable skill in the carrying out of anaesthesia with chloroform under the eye of the medical attendant. If this practice is to be regularised, it is incumbent upon those who are responsible for the training of midwives to see that they are taught during their hospital career how to carry out such simple anaesthesia, and we may look forward to the time when, with the extension of the period of the midwife's training, this will constitute an important element in her instruction.

C. ANÆSTHESIA FOR OBSTETRIC OPERATIONS

I. ANÆSTHESIA FOR CÆSAREAN SECTION

Spinal Anæsthesia.—This procedure, favoured by many experienced surgeons and anæsthetists for Cæsarean section, is strongly condemned by others. A large number of fatalities have been reported, and it is believed by many authorities that spinal anæsthesia should be avoided during pregnancy. If it is decided to employ this method of anæsthesia for Cæsarean section, there should be good reasons for this choice, and

a sound knowledge of its dangers and their prevention. Its use may be justified where inhalational methods are contraindicated, for example, for patients suffering from active disease of the respiratory passages or lungs, or with renal or hepatic insufficiency. The advantages of spinal anæsthesia, which may in certain cases influence its choice, are the marked absence of bleeding from the placental site, the strong contraction of the uterus and the excellent and unnarcotised condition of the newborn baby.

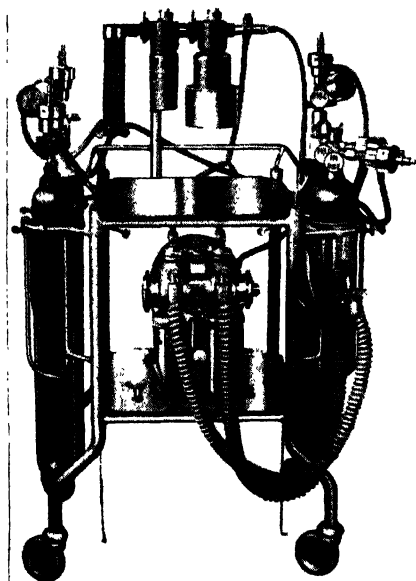


FIG. 147.—Anæsthetic table with Boyle machine, rotameters, and Mushin two-phase closed circuit.

Nitrous Oxide - oxygen.—A special apparatus, and an anæsthetist skilled in its use, are required to obtain the best results with this type of anæsthetic. Nitrous oxide is the least toxic anæsthetic gas

available, and it has no deleterious effects on mother or child, providing anoxæmia is avoided. The stretching of the peritoneum and abdominal muscles during the later months of pregnancy enable satisfactory anæsthesia to be maintained in the lightest plane of surgical anæsthesia with a relatively high percentage of oxygen, and this makes nitrous oxide-oxygen a particularly suitable anæsthetic for Cæsarean section. Should additional relaxation be required, this can be more readily and safely obtained by adding di-vinyl ether (Vinesthene) or cyclopropane to the gases than by the addition of ether.

Cyclopropane, a potent gas administered by a closed-circuit apparatus, possesses properties which make it an excellent anæsthetic for Cæsarean section, and in many clinics it has displaced both spinal and other forms of inhalation anæsthesia as the routine for this operation. Anæsthesia is induced quickly, and maintained smoothly with a high

percentage (60 to 80 per cent) of oxygen, and may be deepened rapidly if necessary. Recovery of mother and child from the effects of the anæsthetic is rapid and uneventful. Recent research has shown that whilst the prolonged administration of nitrous oxide-oxygen containing less than 15 per cent. oxygen may be harmful to the fœtus, cyclopropane alone of the inhalation anæsthetics in use will produce anæsthesia of the mother before it produces changes in the fœtal circulation.

Pentothal Sodium.—Providing there is no objection to its use on general grounds, a small dose (0·3 to 0·5 gram) of pentothal sodium or evipan sodium may be injected intravenously to induce anæsthesia in a nervous patient. This is preferable to sedation with opiates for reasons given above. To provide quieter or deeper anæsthesia with nitrous oxide-oxygen, pentothal sodium may be injected after the birth of the baby. This method should be reserved for those experienced in the technique of intravenous anæsthesia.

Local Anæsthesia is preferred by some operators (see p. 720). It is the method of choice for patients suffering from severe degrees of heart failure, toxæmia, diabetes, bronchitis, asthma, active pulmonary tuberculosis, etc. It is also valuable for abdominal hysterotomy in cases of pulmonary tuberculosis, hyperemesis gravidarum, etc., where inhaled anæsthetics may cause severe liver damage.

Whatever method of anæsthesia is employed, the anæsthetist should make certain that the fœtal heart is beating before the anæsthetic is begun, and that no opiate has been administered to the patient within the previous four hours. If such an injection has been given, unless the operation is an urgent one, it should be postponed.

2. ANÆSTHESIA FOR OTHER OBSTETRIC OPERATIONS

Anæsthetics are well tolerated during pregnancy, and the anæsthetics discussed in the paragraphs above are suitable for other operations referred to in Chapter XL. Care should be taken to prevent respiratory obstruction or overdosage: two lives are at stake, and though the risk to the mother may be small, irreparable damage may be done to the fœtus. Chloroform should be avoided; nitrous oxide-oxygen anæsthesia, supplemented with ether when necessary, is to be preferred, and in all cases the least toxic anæsthetic suitable for the operation to be performed should be chosen.

Local Anæsthesia.—Infiltration anæsthesia of the vaginal introitus and perineal areas has been recommended during the second stage of labour and especially during the final stage to relieve the pain associated with the distension of the lower end of the vagina, the vulva and the perineum. When combined with analgesia by one of the methods described for the actual delivery of the head, the results may be very

satisfactory in a normal, spontaneous delivery. It allows of the performance of an episiotomy and of the repair of the episiotomy wound or of lacerations, and is well adapted for routine practice in spontaneous delivery where a special anaesthetist is not available and the obstetrician is working without adequate assistance. Further, after the termination of the labour, the repair of a perineal tear may be carried out painlessly after infiltration anaesthesia of the surrounding soft tissues.

Pudendal Block anaesthesia is increasingly recognised as a procedure of great value where forceps delivery is called for and where inhalation anaesthesia is contraindicated or where, in the absence of a skilled anaesthetist, the obstetrician is dependent upon his own resources. Some obstetricians employ it as a routine procedure both in spontaneous and in forceps delivery. The patient is placed in the lithotomy position and a superficial wheal is made with a hypodermic needle on each side halfway between the anus and the tuberosity of the ischium. The anaesthetic consists of novocaine (0·5 per cent.) or nupercaine (0·05 per cent.). The index finger of the left hand is introduced into the rectum as far as the left ischial spine. This guides the needle, which should be 10 cm. long and which is pushed through the left-sided wheal up to and just beyond the ischial spine where 10 to 15 c.c. of the anaesthetic solution is injected to block the internal pudic nerve just before it enters Alcock's canal. The needle is withdrawn as far as the superficial wheal and is then pushed as far as the bone of the left ischial tuberosity. It is gradually withdrawn, depositing 5 c.c. of the solution on the way to anaesthetise the large perineal branch of the posterior cutaneous nerve. The needle is again withdrawn as far as the wheal and is then pushed forwards to anaesthetise the tissues of the labium majus. The needle is now completely withdrawn and the above process is duplicated on the right side.

Parasacral Block.—Pudendal block is not suitable where internal manipulations are necessary such as internal version or the bringing down of a foot. Sufficient relaxation of the cervix and uterine body for such purposes can, it is claimed, be obtained by means of parasacral block. The procedure is, however, not sufficiently reliable for routine use by the obstetrician.

PART V
ABNORMAL LABOUR

CHAPTER XXIV

DYSTOCIA—PATHOLOGICAL LABOUR

General Remarks—Prevention of Dystocia—Results and Dangers of Obstructed Labour and of Protracted Labour.

THE subject of normal labour or *eutocia* having been fully considered, we must now turn to difficult and complicated labour or *dystocia*.

GENERAL REMARKS

The difficulties and complications may be pronounced or slight. The more pronounced are comparatively easily recognised, but minor degrees of pelvic deformity, malpositions of the foetus, etc., are readily overlooked. As the slighter difficulties and complications are those most commonly encountered in domestic practice it is necessary that the student of obstetrics should be instructed in the subject of dystocia: but to what extent is always a difficult question for the teacher of Obstetrics anxious to present dystocia in its proper perspective. Reading through the succeeding chapters dealing with dystocia, the student may be staggered by the number and variety of possible complications. Some referred to are great rarities, but many, and all considered in detail, are common occurrences.

Knowledge and experience in practical obstetrics cannot unfortunately be learned from textbooks, and although we shall strive in the following pages to make the subject as clear and simple as possible, and present to our readers a picture of these difficulties and complications, we would emphasise the importance of clinical and practical training.

At the commencement of the study of dystocia let us impress our readers with this all-important fact, that to drag the child out of the parturient canal by *extreme force* is not the method of dealing with a difficult or complicated labour. This procedure is only occasionally necessary or justifiable. The object of the accoucheur should be to correct errors and to extract the child with the least expenditure of force and with the least injury to the mother and child. To do this it is absolutely necessary that the diagnosis is as exact as possible. In approaching every case of dystocia the accoucheur should ask himself: *Why is it that Nature has failed and I am experiencing difficulty in extracting the child?*

The busy practitioner with many patients to visit and exhausted by hours of strenuous work is very much tempted to hasten delivery by

applying forceps or dragging on the limbs when this is quite unnecessary. In vain is it for him to persuade himself that no harm follows this practice—the wards of maternity and gynæcological hospitals tell a different story.

Before considering the various conditions which may cause dystocia our readers must understand that *there are natural variations in normal parturitions*. All women who have a normal delivery do not have exactly similar labours. This is more particularly observed with regard to two features of the labour—namely, the degree of pain suffered, and the duration of the parturition. Thus it comes about that it is very difficult to define *dystocia*, for the border-line between a normal and an abnormal labour may not be clear-cut.

But if it is of great importance that the accoucheur should appreciate the natural variations of parturition, it is equally important that he should recognise when Nature is at fault and requires assistance, and that he should do so as early as possible. He should never presume that a parturition is normal until he has excluded the possibility of its being abnormal.

The practice of obstetrics, therefore, calls for great judgment, experience, finesse, and patience on the part of those who desire to follow it conscientiously and scientifically.

Labour, as pointed out (p. 365), is influenced by three factors : (a) The Forces or Powers ; (b) the Fœtus or Passenger ; and (c) the Parturient Canal or Passage. In all cases an attempt should be made to estimate how far each of these factors is disturbed. This is often difficult, especially in minor forms of dystocia, for sometimes more than one and indeed all three are at fault. The obstetrician must therefore strive to relegate to each its proper significance.

In addition operative interference may become necessary in the interest of the mother and/or child, although the factors of labour may not be disturbed. Take, for example, valvular disease of the heart, phthisis, toxæmia ; for these and other conditions it may be necessary to hasten the delivery, and in some cases to induce labour. Lastly, interference may be called for in complications suddenly developing, such as severe hæmorrhage (antepartum or postpartum), prolapse of the cord.

Before considering the various abnormalities of labour in detail, a word or two about their prevention.

PREVENTION OF DYSTOCIA

The acknowledged triumphs of preventive medicine in so many fields naturally raises the question, How far can dystocia be prevented ? Incidentally reference has already been made to this subject ; but so important is it that fuller consideration of it at this point is deemed advisable.

Until comparatively recent years difficulties and complications of

labour were dealt with as they arose, with the result that to a large extent they presented themselves as surprises. To-day, by means of an exhaustive examination in the thirty-fourth or thirty-sixth week of pregnancy (p. 191), surprises have been reduced to the minimum. The stage has been reached when it may be claimed, and without fear of contradiction, that very few pregnant women need pass into labour with any serious obstetric complication unrecognised beforehand.

All malpresentations and malpositions of the foetus, with the exception of some "face" and "brow" presentations which develop early in labour, can be recognised by palpation, auscultation, and in cases of doubt by radiography. Plural pregnancy, foetal malformations such as hydrocephalus or anencephalus, and intrauterine death, can be recognised by these same methods; here, however, only by radiography is it possible in many instances to reach an exact diagnosis. Malformations of the pelvis can be diagnosed, and for practical purposes the degree of disproportion estimated, by mensuration (p. 522 *et seq.*), and exactly determined by radiography. Take, again, the hæmorrhages of the later months—placenta prævia and accidental hæmorrhage. In the former in a large number of instances there is the warning signal of repeated slight hæmorrhage prior to the severe bleeding which prostrates the patient and places her life in jeopardy; and in the latter there are the warning signals of high blood-pressure and albuminuria. Here also radiography may be of assistance in clearing up the diagnosis.

It transpires, then, that this complete examination in the thirty-fourth to thirty-sixth week permits the attendant accoucheur to cut down uncertainties to (a) slight maladjustments of head to pelvis; (b) prolapse of umbilical cord; (c) strength of expulsive forces; (d) resistance of the soft parts of parturient canal.

Prolapse of cord (p. 499) is always associated with a very high foetal mortality, no matter what method of treatment is employed. The chances of its occurrence, however, if presentation of child is normal (first or second vertex) and maternal pelvis is normal, is approximately only 1 in 1600.

As regards the other two—the forces and the resistance of soft parts—there is very definite clinical evidence that the former is generally adequate and the latter seldom abnormal. The evidence is the low rate of forceps delivery in well-organised maternity services conducted on conservative lines (2.5 to 5 per cent. forceps deliveries).

The abnormalities which can be corrected are for the most part faulty presentations and positions of the foetus; the advantages, for example, of converting a breech into a vertex presentation far outweigh the disadvantages and dangers (placental separation, prolapse of cord), as we point out in due course (p. 464).

As regards pelvic disproportion, the most that can be done for the primigravida is to make preparations for "trial" labour (p. 528) or Cæsarean section (p. 532). Induction of labour is unsuitable for the

primigravida (p. 528); but may be employed with great advantage in the case of the multigravida.

The recognition of abnormal conditions, the planning out beforehand how an abnormality should be approached, if it cannot be corrected—in other words, antenatal supervision in the complete sense of the term—is one of the greatest, if not the greatest advance which has ever occurred in the whole history of obstetrics; even in its present incompleteness it has been of incalculable advantage to countless expectant mothers.

RESULTS AND DANGERS OF OBSTRUCTED LABOUR

So far we have referred to restraint in interference and to the gross abnormalities which necessitate interference. We must now direct our readers' attention to the results which may follow a protracted labour where the abnormal conditions referred to have not been removed or dealt with. Naturally, both the mother and child suffer; indeed, in many instances one and sometimes both lose their lives. Such unfortunate results, however, do not occur suddenly: there is a gradual working up to them.

The danger signals in an obstructed labour may be summed up in the term "distress." *On the mother's side*, the earliest indication of distress is an increase in the pulse-rate. At first this increase may be slight, but before long it becomes more marked. Generally later, but sometimes contemporaneously with the increased pulse-rate, there is a rise of temperature. It is often slight; indeed, the rise may not amount to more than half a degree, and it is by no means constant. Much more important is increasing restlessness, not simply uneasiness due to "the pains," but manifestations of general restlessness even in the intervals between them. In addition, the patient complains of tenderness over the lower part of the uterus independent altogether of the uterine contractions. Pressure over the lower uterine segment aggravates the tenderness. An overdistended bladder may also be associated with suprapubic tenderness. The differential diagnosis of the two conditions is simple, for a distended bladder can be seen, and if a catheter is passed large quantities of urine are withdrawn.

Still later, it will be found that the intervals between the pains become shorter until one pain runs into another and the uterus passes into a state known as "tetanic contraction" (p. 436). By the time this stage has been reached a marked alteration in the lower uterine segment will have occurred, and Bandl's ring, which marks its upper limit, can generally be felt running obliquely across the uterus above the symphysis pubis. The patient's condition is now very parlous, for the uterus is on the point of rupture (*vide* Rupture of the Uterus, p. 599). She should not be permitted to drift into this condition.

Before she has reached such a state delivery of the child should have been completed by some operative procedure.

The signals of foetal distress are not so obvious. Indeed, careful watchfulness on the part of the obstetrician in charge is necessary if they are to be recognised early. Here the first danger-signal is a decrease in the foetal heart-rate. From 140 or 130 it falls to 120, 110, 100. Not only should the rate be taken, but the influence of uterine contractions upon the heart-sounds should be noted. At all times the foetal heart-sounds become slower during a uterine contraction; but if the child's vitality is undisturbed they quickly return to the ordinary rate as the "pains" pass off. When they return slowly, and especially if they become irregular after a contraction, there is no time to lose if the child is to be saved; but in hastening delivery great caution must be exercised. If the presenting part is low in the pelvis delivery can be easily effected. On the other hand, if the presenting part is high in the pelvis and/or the cervix not fully dilated there is great risk of serious injury being inflicted on the mother or child by forcible extraction—in such cases it is most important to complete the dilatation manually prior to exerting traction on the child and to be satisfied that interference of this nature is justified and advisable—in some instances Cæsarean section may be the wiser choice.

Another significant feature is a progressive enlargement of the caput succidaneum.

A later indication of foetal distress is escape of meconium. We shall see that escape of meconium is a normal occurrence in the second stage of labour where the breech presents (p. 461). But in all other presentations discharge of meconium in quantity indicates that the child is in great danger and can only be saved by a speedy delivery. Immediately before the death of the foetus there is one other symptom of distress—namely, violent foetal movements. These two symptoms indicate that oxygenation of the child's blood is being progressively interfered with. So pronounced may this become that the child may make respiratory efforts as a result of stimulation of the respiratory centre by the ever-increasing carbon dioxide in its circulation. Very occasionally it may actually cry *in utero* (*vagitus uterinus*) if air has been introduced into the uterine cavity while the operator is carrying out intrauterine manipulations.

In this connection the *relative claims of mother and child* must be considered. In dealing with the complications of parturition we are often faced with this difficult problem, for the treatment which is best for the mother may not be so satisfactory as regards the child; and *vice versa*, the ideal treatment for the child may endanger the life of the mother. On occasions, it may be unwise to attempt to save a child whose vitality has been seriously prejudiced by an obstructed labour, because in the circumstances few children survive delivery or the first few days of neonatal life. The mother, therefore, should be

given first consideration—the procedure selected should be that which is safest for the mother.

The picture here presented of a prolonged labour illustrates more particularly dystocia due to obstruction ("obstructed labour") caused by (a) faulty position of child (shoulder presentation, mento-posterior position of face, occipito-posterior position of vertex, malformations—*e.g.* hydrocephalus), (b) pelvic deformity or disproportion. Distinct from this and with problems of its own is the *protracted labour* due to inertia of the uterus and/or rigidity of the soft parts. Its special dangers are exhaustion and acidosis, which may be important factors in inducing Obstetric Shock (p. 571).

CHAPTER XXV

DYSTOCIA (*continued*)

A. FAULTS IN THE FORCES

Undue Strength of the Forces (Precipitate Labour)—Inefficiency of the Forces—Tetanic Contractions of Uterus—Localised Contractions of Uterus

ALTHOUGH faults in the expulsive forces are a common cause of delay it must be admitted that this explanation is given too readily in a large number of instances. It is so simple and vague that the accoucheur is tempted to be satisfied with it, whenever the cause of dystocia is not strikingly apparent. *In practice, therefore, it is a good rule to attribute delay and difficulty in labour to faults in the forces only when faults in the passage or passenger can be excluded.*

In approaching this subject of the forces as a factor of dystocia, we are arrested at the outset by the fact that there is no exact means of estimating the forces. With dystocia associated with the passage and passenger, we shall see that it is quite otherwise, for by careful investigation the degree of difficulty may be fairly correctly determined.

Early in labour the only means of estimating the strength of the forces is the simple expedient of applying a hand over the abdomen and determining the frequency, duration and effect of the uterine contractions. In the second stage, when the head has descended to the pelvic floor, progress is noted by the character of the pains and the progressive distension of the perineum.

Numerous experiments have been carried out with the purpose of observing the effect that various drugs have upon uterine contractions. In the human subject this has been done by the device of inserting a small rubber bag between the membranes and uterine wall and attaching this to a column of mercury from which another tube passes off to a revolving drum on which the contractions can be recorded. The illustration here shown indicates the results of such an experiment (Fig. 148). Instruments for application over the uterus, and held in position by straps round the patient's body, have been devised for the purpose of registering the strength of the uterine contractions; so far the results are unreliable and the instruments of little if any practical value.

The expulsive forces may be abnormal in three respects : (a) unduly strong (precipitate labour) ; (b) unduly feeble and inactive or atonic (inertia) ; (c) continuous (tetanic).

(a) **Precipitate Labour.**—Although excessively strong uterine contractions and the resulting condition of precipitate labour do not, properly speaking, come under the heading of dystocia, there is no more suitable place than here for considering the subject.

Precipitate labour seems to be peculiar to certain individuals. It is not due entirely to excessive strength of the uterine contractions although this is often present, but also to the fact that in a large number of instances the soft parts of the parturient canal offer unusually little resistance. Very often there are only one or two "pains," indicating that the process of dilatation of the cervix, usually associated with much suffering, occasionally does not disturb the nervous system to any extent and is attended by little if any pain.

The ordinary dangers of precipitate labour are laceration of the

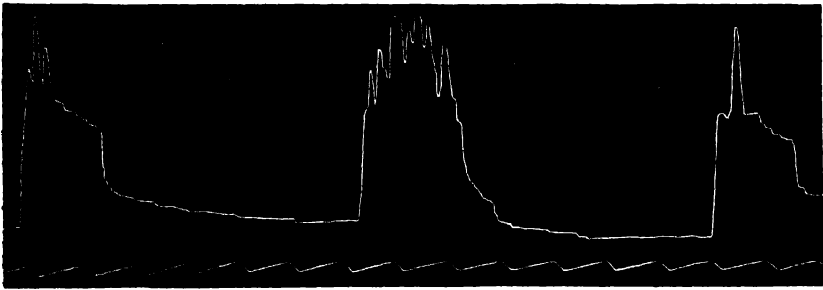


FIG. 148.—Uterine Contractions registered on Revolving Drum.

perineum, postpartum hæmorrhage, and injuries to the child such as rupture of the cord, fracture of the skull, if the child is forcibly expelled from the parturient canal with the mother in the erect posture. One occurrence of medico-legal importance is that occasionally the violence of the "pains" may lead to a condition of temporary mania and the distracted mother may do injury to her child. This plea if sustained in a court of law exonerates the mother from a charge of infanticide.

Other accidents to the mother occur occasionally, such as emphysema, fracture of the sternum, owing to the great strength of bearing-down efforts (p. 607).

Treatment.—Generally speaking, the medical attendant has little chance of treating this condition, for labour is generally over before his arrival. Should he be present, however, while these extremely severe contractions are occurring he will naturally try to lessen them by the administration of an anæsthetic. In this country we still employ chloroform ; but the whole subject of anæsthesia in labour is discussed

elsewhere (p. 418). It is profitless in cases of this kind to advise the patient not to bear down, for her control over the auxiliary or bearing-down forces is gone.

Patients who are in the habit of having precipitate labours should see to it that they are never far from home during the weeks preceding labour; otherwise they may be placed in a very awkward and humiliating position should labour come on suddenly and unexpectedly.

(b) **Uterine Inertia.**—Uterine inertia is generally divided into (a) primary and (b) secondary inertia, the former being attributed to inherent weakness from uterine hypoplasia or faulty innervation, and the latter to exhaustion from prolonged and severe uterine activity.

There are undoubtedly more subtle causes underlying primary, and possibly also to some extent secondary, uterine inertia. We have seen that the hormone or hormones from the posterior lobe of the pituitary gland are held in check for the first half of pregnancy by progesterone. Until recently it was thought that as this influence wears off œstrin, accumulating in the blood, sensitised the uterus to the oxytocic hormone (pitocin) of the posterior lobe. The hormonal mechanism is much more complicated however (*vide* p. 185); but there is consensus of opinion that primary inertia is in many instances the result of hormonal maladjustments. Probably also as Kreis maintains, it is due to slight anatomical or structural variations in the cervix as primigravidæ are particularly prone to uterine inertia.

The classification into primary and secondary inertia is not completely satisfactory. We think, therefore, that we can give the student a better idea of the significance of inefficiency of the forces if we discuss the subject under the heads of: (a) delay in the first stage of labour; and (b) delay in the second stage.

DELAY IN THE FIRST STAGE OF LABOUR.—Before discussing this subject it must be clearly understood that all other causes of delay, such as mechanical obstruction, rigidity of the cervix, are excluded—they are considered later in connection with dystocia due to faults in the passage (p. 539). We are here concerned with delay in the first stage, the result of faulty uterine contractions.

Uterine contractions to be effective should possess three characteristics: they should occur at regular but not too long intervals, they should be strong, and they should be sustained. As labour advances each of these features becomes more pronounced. Very frequently, however, during the course of labour these features vary from time to time both as regards the interval and severity of the "pains"; indeed, it often appears as if the uterus took short periods of rest. Within certain limits this may be considered a natural occurrence which, although it may lead to a little prolongation of the first stage, is not of any real significance.

In most instances inertia is due not so much to weakness of uterine muscle but rather to something inhibiting uterine activity. For

example, it will often be found that an overdistended bladder or bowel inhibits uterine contractions. Overdistension of uterus from hydramnios or plural pregnancy may have a similar effect. Very commonly the presence of the medical attendant, and certainly in a number of cases also the mental strain and *fear of the pains* coming on, arrest uterine action. This must not be understood to imply that the individual by her will can exercise any control over the occurrence of uterine contractions, for this, as we have already seen, is not the case. This inhibitory influence of *fear* in all its gradations is most important. Whether it is always hormonal (through the suprarenals), or, in its minor degrees, is mental and confined to the nervous system and uterine innervation cannot be stated with certainty. We have already stressed the intimate correlation between the hormones of ovary and pituitary gland in influencing uterine action.

In connection with innervation, it will be found that anything, such as faulty position of head or pelvic disproportion, which interferes with the pressure of the presenting head on the cervix is associated with feeble uterine action and prolongation of the first stage of labour—here there exists a lessening of reflex stimulation.

Treatment.—Where the disturbing influences are obvious the treatment is simple. The bladder should be kept empty and the bowel should be thoroughly evacuated at the commencement of the labour. Where the delay is due to overdistension of uterus the membranes should be ruptured, even although the dilatation of the cervix has made comparatively little progress. Most important in many instances is the administration of some sedative such as bromide and chloral, morphia, omnopon, or, better still, scopolamine and morphine, with the object of allaying all nervousness (p. 416). It is surprising in this stage how rapid the progress may be following the administration of sedatives, provided the sedatives are not given in too large doses. Nor should one neglect the psychological effect of robust but considerate encouragement on the part of midwife, or doctor and nurse, in attendance—this influence may delay the call for sedatives early in labour.

A word is necessary at this point regarding a procedure which has come to be employed very frequently—viz., artificial rupture of membranes early in labour. We are opposed to the too free employment of this procedure. On the other hand, we think that judiciously employed it is often useful. The subject is more fully considered in connection with Induction of Labour (p. 732). Treatment by drugs, other than sedatives already mentioned, has proved disappointing so far. Oxytocics such as pituitrin and ergot and its derivative (ergometrine) are in small doses ineffective and in larger doses dangerous in the first stage. Conflicting are the views expressed regarding quinine. Thymophysin has not proved as satisfactory as was at first claimed by its advocates.

Possibly, when hormonal influences are better understood, hormones suitably adjusted may be found to be of great benefit; but as in dysmenorrhœa so in uterine inertia the results have not come up to expectation, except in respect to that of the posterior lobe of the pituitary gland.

Jeffcoate¹ has reported favourably of œstrone and œstriadol benzoate in uterine inertia in both stages of labour, provided there is no mechanical obstruction. Response is immediate in some, but in others not until an hour or two has transpired. Not all obstetricians have had as fortunate an experience with those drugs.

DELAY IN THE SECOND STAGE.—In this stage, as there are two forces concerned—namely, the uterine contractions and the auxiliary or bearing-down forces—we may find that the fault is in either or both. Delay may be due to overdistension of the bladder and the other conditions which we have seen inhibit uterine contractions in the first stage. But more important in this stage is the inertia which results from temporary uterine exhaustion. All muscle becomes fatigued in time, so it is not surprising that the uterine muscle becomes exhausted.

Very commonly, however, delay in this stage is not due altogether to faulty uterine contractions but to feebleness in the auxiliary forces. A considerable amount of the strength of the uterine contractions and the auxiliary forces in the second stage is reflexly set up by the mechanical stimulus of the presenting part on the pelvic floor. Feebleness, therefore, of the forces not infrequently results from non-descent or faulty descent of the presenting part—*e.g.* occipito-posterior positions (p. 441). This can be demonstrated, if the patient is lightly anaesthetised, by pulling upon the perineum or introducing the hand or a blade of the forceps into the vagina, each of which reflexly augments the frequency and severity of the uterine contractions and bearing-down efforts. In this connection it must also be remembered that *all sedatives dull down the pelvic floor reflex*. This is one of the strongest arguments against the too free employment of sedatives and the price which must be paid for their employment.

As regards treatment, it is obvious that there are three courses which may be pursued: (a) stimulation of the forces; (b) termination of the labour by extraction of the child; (c) giving the patient a rest.

Many stimulants to uterine contraction have been suggested and employed—*e.g.* massage of the uterus, hot vaginal douches. They, however, are of relatively little importance compared to such drugs as ergot and its derivatives, and pituitary extract. We have not included quinine as a uterine stimulant in the second stage—it is questionable if it is of much value for inducing premature labour (p. 734). Ergot, ergometrine and pituitary extract have an almost immediate effect in causing strong uterine contractions.

¹ First Blair Bell Memorial Lecture. *Journ. Obst. and Gyn., Brit. Emp.*, 1938, vol. xlv., No. 6, p. 873.

They are, however, dangerous drugs used unwisely. This was proved in the case of ergot long years ago, and it has gradually come to be realised that pituitary extract is nearly as dangerous. We must caution our readers against the indiscriminate employment of pituitary extract for the purpose of hastening the second stage of labour. Unfortunately, this word of caution is necessary. There are now many cases on record in which rupture of the uterus, severe vaginal lacerations, and/or retention of the placenta have resulted from the use of pituitary extract. *Pituitary extract should only be employed in the second stage of labour in multiparæ, and in them only if the head is at the outlet and there is no abnormality in fetal formation, presentation and position, or in the parturient canal.* In such cases 0·5 c.c. pituitary extract may be given as an alternative to the application of forceps.

Artificial extraction of the child is the general course followed. Now, provided there is no contraindication, Nature has been given every chance to effect delivery, and extraction is not employed simply for the convenience of the accoucheur but in the interests of mother and child, there is no objection to completing the delivery by means of forceps—indeed it is indicated. This amounts to nothing more than assisting the head through the vaginal outlet. It may be put thus: if *incipient* inertia is recognised, forceps is indicated; if *pronounced* inertia has developed forceps is contraindicated, but complete inertia should be anticipated. In such cases the accoucheur must have everything in readiness to combat postpartum hæmorrhage should it occur.

As regards the third alternative—giving the patient a rest—here, too, discretion must be exercised. There are two great objections to employing sedatives, more especially morphia, at this stage: (a) they dull down the pelvic floor reflex, and (b) they endanger the life of the child (p. 618). Therefore when the second stage has lasted two to three hours, and before that time if there are other indications for interference, the child should be extracted with forceps.

Prolongation of labour as one sees it most markedly in rigidity of cervix is considered elsewhere (p. 543). The ordinary slighter delay to which we have just referred is not so serious, nevertheless everything must be done to control exhaustion and acidosis—the importance of glucose in combating both these conditions has been already stressed (p. 403).

Tetanic Contractions of Uterus.—Tetanic contraction of the uterus (tetanus uteri) is a condition observed in pronounced dystocia, where the uterus has been long trying to overcome an obstruction—*e.g.* pelvic deformity, impacted shoulder presentation, hydrocephalus. It may develop if ergot or pituitary extract have been injudiciously administered. The condition was considered in the previous chapter under Obstructed Labour (p. 428).

Localised Contractions of the Uterus.—This form of irregular

contraction may occur both in pregnancy and labour. It is specially liable to occur at the orifices where circular muscle fibres are most abundant—os internum and externum, and openings of the Fallopian tubes.

Reference has already been made to irregular contractions of the uterus during pregnancy.

During labour localised spasmodic contractions ("false pains," p. 374) often cause considerable discomfort. When they occur about the retraction ring (*strictura uteri*), or about the external os (*trismus uteri*, spasmodic rigidity of the cervix), they may interfere with the birth of the child or placenta—they are considered in Chapter XXXI, pp. 541-547.

CHAPTER XXVI

DYSTOCIA (*continued*)

B. FAULTS IN THE FŒTUS OR PASSENGER

Malpositions and Malpresentations of the Head—Occipito-posterior—Deep Transverse Arrest—Face—Brow—Prolapse of Limbs—Pelvic Presentations—Breech, Foot and Knee—Shoulder Presentation (Oblique or Transverse Lie)
—Arm and Elbow Presentation—Compound Presentation

OCCIPITO-POSTERIOR POSITIONS OF THE VERTEX

IN a textbook written primarily for students we cannot discuss this very controversial subject in too great detail. We must, however, deal with it more fully than some other complications because the two occipito-posterior positions (third and fourth vertex) constitute the commonest of the minor complications of obstetric practice as they are encountered in 20 to 25 per cent. of all vertex presentations.

Prior to labour the long axis of the child's head (occipito-frontal) lies transversely *qua* the pelvic inlet (p. 384), tilted, however, very often a little obliquely—in a few instances it may actually lie in one of the oblique diameters (first, second, third and fourth vertex positions).

When labour supervenes, often even in the "premonitory stage" these four cardinal positions become more general; but in a number of instances the long axis of the head remains in the transverse diameter of the pelvis. Persistence of the transverse position right down to the outlet leads to what is known as "deep transverse arrest" (p. 448).

A number of obstetricians had come to recognise these facts by simple abdominal palpation—radiography has confirmed their observations. It has done more, it has demonstrated that the position assumed by the head is influenced by two factors—viz.: (a) the formation of the pelvis and (b) the position of the back of the child.

In the chapter devoted to pelvic malformations there is a special section (pp. 534-538) which deals with "minor variations in pelvic formation." These variations were known to anatomists from the study of dry pelvis in anatomical museums, but their significance, in respect to the mechanism of birth, was not appreciated by obstetricians until radiography demonstrated their existence. The minor pelvic variations which favour occipito-posterior positions of the vertex are the *android* and *anthropoid* types (p. 536), and the *high assimilation pelvis* (p. 512). We do not wish to stress unduly the importance of

radiography in this particular connection. Our readers will realise how easy it is to slip into the error of exaggerating the importance of any new method of examination, and particularly its application to treatment where the radiograph shows only slight departure from the normal pelvic formation.

Let us consider now the other influencing factor—the *position of the back*. The back of the child is situated on one or other side of the uterus and is directed somewhat forwards or backwards—and very much oftener forwards than backwards, which is not surprising if one bears in mind the projection forwards of the lower spinal column of the mother. Position of head as affecting position of back has for long been recognised ; but position of back as affecting position of head has

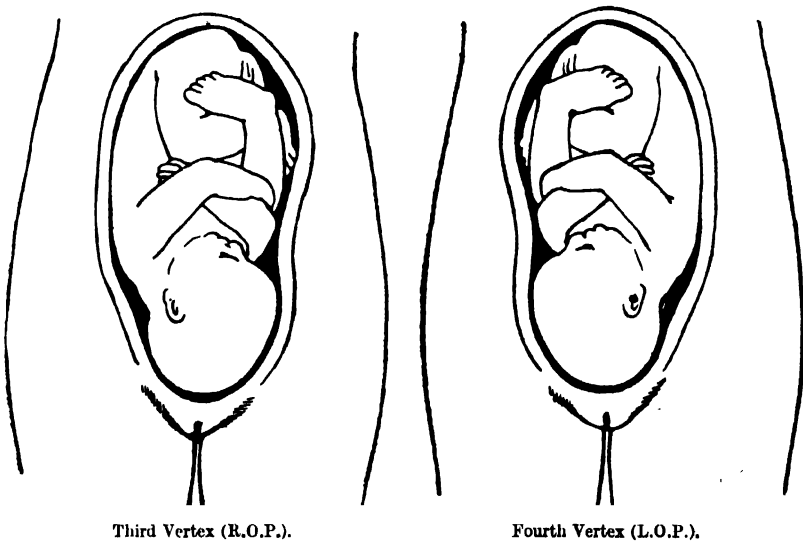


FIG. 149.—Occipito-posterior Positions of Vertex—occasionally existing before Labour (primary), but more generally assumed after Labour has started (secondary).

only been stressed recently by a few writers—"revived" is perhaps the more correct term, as a number of the older writers do make reference to this particular point. Here again the exactness of radiographic examination has furnished important information. It has to be borne in mind, however, and this too has been demonstrated in radiographs, that *owing to the flexibility of the neck a degree—sometimes quite a considerable degree—of torsion of head on trunk may occur if there is deflexion of the head as pertains in occipito-posterior positions.*

Diagnosis.—LATER WEEKS OF PREGNANCY AND EARLY IN LABOUR.
—A true (primary) occipito-posterior position is relatively infrequent prior to labour. Even during the later days of pregnancy alterations in the decubitus of the patient—from recumbent to the erect posture, or turning in bed from one side to the other—may alter the position of the child until the head becomes fixed in the pelvic brim. The most

to be concluded is that the likelihood of a posterior position developing is proportionate to the degree to which the back of the child is directed posteriorly. *Further, the probability of an occipito-posterior position is three times as great if the child's back is on the right side than if the back is on the left side*; because the torsion of the uterus to the right and the presence of the rectum on the left side tend to maintain a forward position of the back located on the left side.

When the vertex assumes the occipito-posterior position prior to labour ("primary") or takes up this position after labour has started ("secondary") certain definite features can be recognised by inspection, palpation and auscultation. It is only after labour has made considerable progress that much can be learned from a vaginal or rectal examination.

Inspection.—With posterior positions of the vertex there is

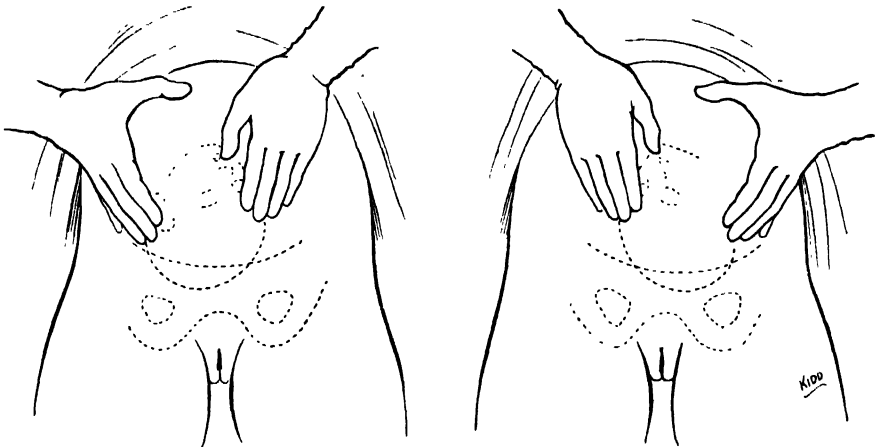


FIG. 150.—Abdominal Palpation of an Occipito-posterior Position of Vertex. Note the two hands are about the same level because there is deflexion of head as described below.

frequently observed a slight flattening of the distended uterus and a depression between the upper and lower foetal poles. The configuration resembles the appearance of the abdomen when the bladder is over-distended (p. 552). If there is any doubt that the latter condition exists a catheter should be passed and the bladder emptied.

Palpation.—The most striking feature in occipito-posterior positions of the vertex is the ease with which the limbs can be felt and the visible active movements of the limbs. On the other hand, there is difficulty in defining the back. It has been already indicated that the foetal head in a primigravida becomes fixed in the pelvic brim in the late weeks of pregnancy. With occipito-posterior positions (primary) this is not so pronounced, for the head is less flexed. And so it comes about that the hands of the examiner defining the sinciput and occiput respectively are at very nearly the same levels, although the one defining the occiput is always a little lower (Fig. 150).

Auscultation.—As the back of the foetus is posterior there is sometimes difficulty in hearing the foetal heart-sounds. Generally they are best heard well round to the side towards which the back is directed. Thus in the third vertex "R.O.P." they are heard best to the right, and in the fourth vertex "L.O.P." to the left (*vide* Fig. 81, p. 173). But in a few instances, if there is very marked deflexion of head and trunk, the foetal heart sounds may be heard best over the ventral aspect of the child, as in face and brow presentations (p. 450).

Vaginal Examination.—As the head does not fit the pelvis so exactly as in the ordinary first vertex position it is difficult to reach the presenting part early in labour. It stands to reason, therefore, that the markings by which the position of the head is determined are difficult to define until the head has descended some little way into the cavity. There is one striking feature which should always arouse suspicion in the mind of the accoucheur that he is dealing with an occipito-posterior position—namely, the *ease with which the anterior fontanelle is felt*. This fontanelle is directed forwards and to the left in the "third vertex," and forwards and to the right in the "fourth vertex," position.

What is stated in the foregoing paragraph applies more especially to the days when a diagnosis of presentation and position was made entirely by vaginal examination. Having satisfied oneself by palpation that the presentation is the vertex it is inadvisable to make a vaginal examination early in labour to determine the position.

Early Rupture of Membranes.—This occurs in 30 to 40 per cent. of cases. In a large proportion of cases in which it occurs the occiput rotates backwards.

LATER IN LABOUR.—If the malposition has not been diagnosed early it should be suspected when undue delay occurs in the descent of the head, and if the membranes have ruptured early—the characteristic features noted by palpation have already been described. Then on vaginal examination, if the ordinary "landmarks" on the foetal head are obscured by the caput succedaneum, as is sometimes the case, search may be made for the pinna of the ear—obstetricians of the past attached great importance to the direction of the pinna in diagnosing malpositions of the head.

At this stage a correct diagnosis is possible by *rectal examination*, indeed there is much to be said in favour of rectal examination for noting progress of descent of the foetal head (p. 402).

Mechanism of Birth.—The mechanism of birth in third and fourth vertex positions is most interesting, for the head may take either (*a*) a long rotation, which brings the occiput to the front, or (*b*) a short rotation, which ends in the occiput rotating into the hollow of the sacrum.

Long Rotation.—This is the common termination, and occurs in between 80 to 90 per cent. of occipito-posterior positions. It is naturally the most favourable.

If the progress of labour is carefully watched in an occipito-posterior

position it will be noticed that at a certain stage of the labour, just as the head reaches the pelvic floor, it becomes more flexed. The anterior fontanelle, which up to this time could be easily felt, becomes more difficult to reach; while, conversely, the posterior fontanelle becomes more accessible (Fig. 151, B). Sometimes during a single "pain," on other occasions by a more gradual process, the occiput comes round to the front, rotating through a second vertex (Fig. 151, c) if the position has been a third, and through a first vertex if the position has been a fourth. This brings the occiput behind the symphysis pubis (Fig.

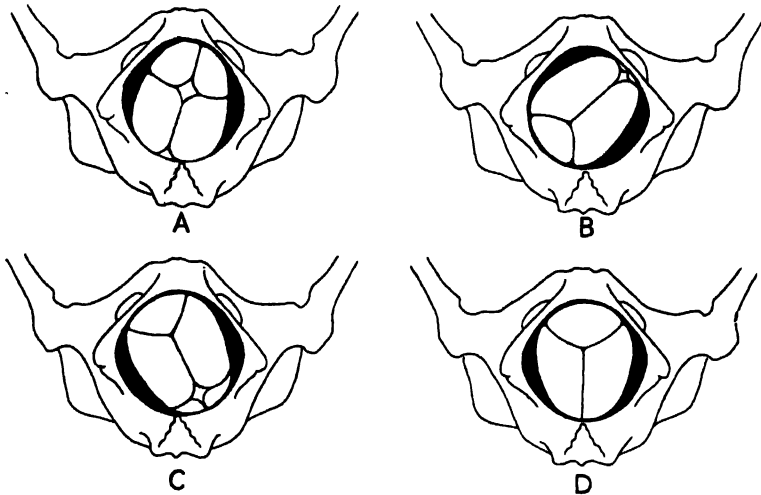


FIG. 151.—Movements which the Head undergoes in "Long Rotation" of a Third Occipito-posterior Position of the Vertex.

A. Third vertex position.

C. Long rotation into second position.

B. Flexion prior to rotation.

D. Full rotation occiput now forward.

151, D). The birth of the head now takes place in the manner already described for occipito-anterior positions (p. 394).

Short Rotation.—This takes place in between 10 and 20 per cent. of occipito-posterior positions, and is very much less favourable than the "long rotation." When it occurs the anterior fontanelle remains permanently low and easily felt. In other words, imperfect flexion persists. The head descends to the pelvic floor, and the occiput rotates into the hollow of the sacrum. The condition is now described as a *persistent occipito-posterior position*. Should spontaneous birth take place it will be observed that the area between the forehead and bridge of nose is pressed against the symphysis pubis followed by an increase of flexion, with the result that the occiput is driven over the perineum. Finally, the forehead and face come from behind the symphysis pubis by a movement of extension. These stages in the delivery are shown in the accompanying illustration (Fig. 152). Spontaneous delivery in this form is often referred to as birth "face to pubes"—it occurs in somewhere about 20 per cent. of cases of persistent occipito-

posterior positions and is most likely to occur in the anthropoid type of pelvis (p. 536).

Radiography has demonstrated beyond any question that formation

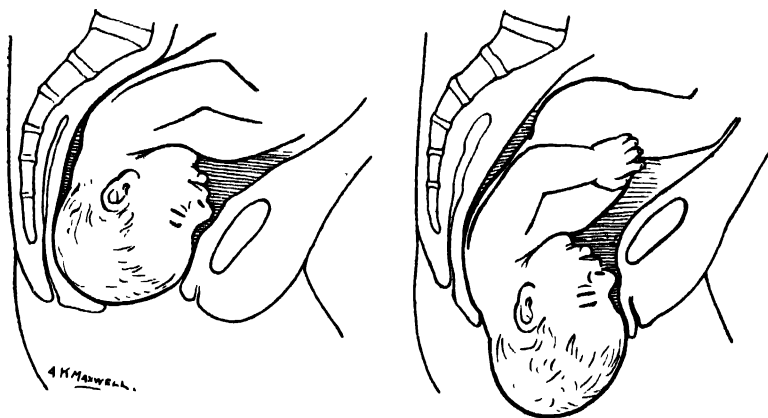


FIG. 152.—Mechanism of Birth in a Persistent Occipito-posterior Position—often referred to as birth “Face to Pubes.”

of pelvis is the most important factor in determining (a) engagement of head in an occipito-posterior position and (b) whether a long or a short rotation will occur.

SUMMARY OF MECHANISM OF BIRTH IN OCCIPITO-POSTERIOR POSITIONS

THIRD VERTEX

Long Rotation

Head right oblique occiput posterior (R.O.P.).

Descent.

Flexion.

Rotation into “second vertex” (R.O.A.).

Rotation into conjugate.

Birth of head as in occipito-anterior position.

External rotation as shoulders descend (p. 394).

FOURTH VERTEX

Head left oblique occiput posterior (L.O.P.).

Descent.

Flexion.

Rotation into “first vertex” (L.O.A.).

Rotation into conjugate.

The degree of rotation of shoulders depends largely upon the original position of shoulders and the extent to which they have followed the rotation of the head. In some instances there is a true *restitution* and the face comes once again to be directed forwards, because the shoulders have not rotated forwards.

Short Rotation

(Spontaneous delivery—20 to 30 per cent. if left alone.)

Occiput rotates into hollow of sacrum.

Forehead pressed against symphysis.

Head born by flexion occiput sweeping over peritoneum.

Lastly, by extension, face comes from behind symphysis pubis.

The student will naturally ask for an explanation of these movements and more particularly of the long rotation which the head so often takes. Many theories have been advanced, but the most probable and satisfactory is the one suggested by the late Berry Hart—that the part of the foetal head which strikes the floor of the pelvis first is rotated forwards. If the occiput does so—as occurs if the head becomes well flexed—then it comes to the front and the long rotation occurs; if, on the other hand, the sinciput or forehead strikes the floor first—as occurs if the head remains deflexed—then it is directed forwards and the occiput backwards (persistent occipito-posterior position).

There is clinical evidence in support of this theory, for we find that long rotation is the rule with a normal pelvis and a head of average size—both of which conditions imply resistance to the descent

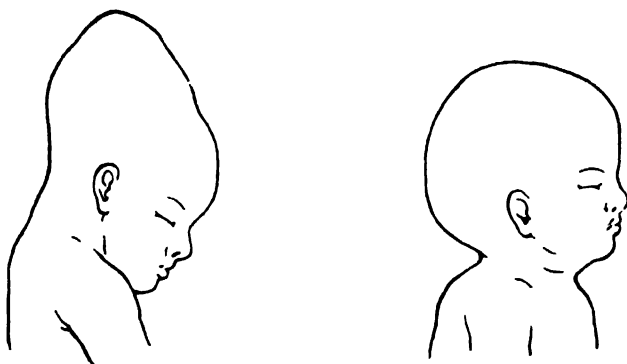


FIG. 153.—Left-hand Figure moulding in Occipito-anterior positions. Right-hand Figure moulding in Persistent Occipito-posterior Positions.

of the head, and consequently good flexion. Further, experiments in the post-mortem room support the theory, for if a foetus is pushed down through the pelvis with its occiput posterior the occiput rotates forwards, provided, and as long as, there is good resistance in the pelvic floor. The authors of this work are not entirely satisfied that the above is the explanation in all instances; they are of opinion that in some cases the general pelvic formation and in others the position of the back is the determining factor. *It appears, for example, from radiographic examinations that the short rotation resulting in a persistent occipito-posterior position is very frequently observed in the anthropoid type of pelvis (p. 537) and furthermore, that in such a type spontaneous delivery "face to pubes" generally occurs.*

The Caput Succedaneum and Moulding.—The caput succedaneum in occipito-posterior presentations is especially pronounced on the left parietal bone in a third position and on the right parietal bone in a fourth position. Should anterior rotation occur it extends farther back and more closely corresponds with the one which forms in occipito-

anterior positions. But in persistent occipito-posterior positions it continues to develop on the original sites. The moulding which the head undergoes also varies. If the occiput takes a long rotation the head is elongated, as already indicated in occipito-anterior positions. Should, however, the case terminate as a persistent occipito-posterior position the shape of the head is more globular (Fig. 153).

Prognosis.—The prognosis is less favourable for mother and child in occipito-posterior positions. Compared with occipito-anterior positions the mortality and morbidity, both maternal and foetal, are distinctly higher, especially where the malposition is not corrected and the head is delivered with forceps in a persistent posterior position. The reasons for this are obvious. The labour is more prolonged, vaginal examinations are more frequent; if manual manipulations are employed the risks of infection are increased. Then if the head is delivered “face to pubes” the soft parts of the mother are often badly torn because the longer occipito-frontal diameter of the head is thrown across the vaginal outlet. The difference between this diameter and the more favourable sub-occipito-bregmatic is $\frac{3}{4}$ inch (2 cm.), which does not appear a matter of much consequence. If, however, the difference is considered in terms of the respective circumferences it reaches 2.5 inches (6 cm.). The lacerations of the vagina are often very extensive and run deeply into the perineal floor, injuring not only the smaller muscles of the perineum but even the levatores ani and coccygei muscles.

Then as regards the child, intracranial injuries are particularly liable to result in occipito-posterior positions, delivered as such with forceps, because considerable force is necessary to extract the head, the forehead is unduly pressed against the symphysis pubis, and the forceps are liable to slip off the head.

Management of Occipito-posterior Position.—**PROPHYLACTIC ROTATION BEFORE LABOUR.**—The treatment consists in applying long pads suitably placed up the sides of the uterus—the pads are held in place by an abdominal binder. Buist and others claim many successes for this treatment. As we have seen, most cases supposed to be occipito-posterior positions, because of the ease with which the limbs can be palpated, are in reality transverse positions of the vertex. If these cases are included as examples of occipito-posterior position, rotation can be effected easily; but the great majority rotate forward if left alone. The *primary* occipito-posterior position (third and fourth vertex) is difficult to rotate and to retain in the altered position, according to the experience of the authors. Furthermore, they would point out that pads and binder in such circumstances aggravate the malposition. They advise, however, that the *patient should be instructed to lie as much as possible on the side opposite that to which the child's back is directed.*

MANAGEMENT OF LABOUR.—Long rotation does not occur as a

rule until labour has advanced considerably in the second stage. *Consequently, the first essential is to give Nature plenty of time.* The correction must not be postponed too long, however, otherwise the uterus retracts so firmly upon the foetus that manual correction of the presentation becomes difficult and may be ultimately impossible. It is not easy, therefore, to lay down, in writing, hard-and-fast rules as to when to interfere. Generally speaking, if with strong uterine contractions there is no evidence of flexion, two hours in the second stage is quite long enough. Further, if before this time the head has definitely rotated into the conjugate with the occiput posterior, manual rectification should not be postponed, because spontaneous birth can

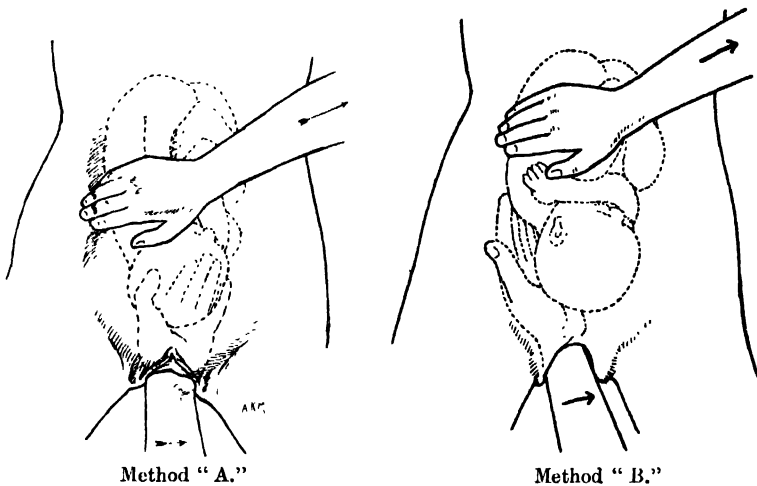


FIG. 154.—Two Methods for rotating an Occipito-posterior Position of the Vertex.

now only occur with “face to pubes”—a mode of birth which involves a prolongation of labour, occurs only in some 10 to 20 per cent. of cases, and is associated with a relatively high foetal mortality and morbidity. Lastly, if the back of the child is very pronouncedly posterior, interference is advisable. *If, however, a radiographic examination has been made and the pelvis is proved to be of the “anthropoid” type, the labour should be allowed to proceed, as spontaneous birth “face to pubes” generally occurs and without serious consequences to the child.*

Manual Correction.—There are two methods of manually correcting this malpresentation, and in the hands of experienced obstetricians they are successful in 90 to 95 per cent. of cases if employed early enough.

Method A.—It will be observed that in this method (Fig. 154) the accoucheur passes his whole hand into the vagina, grasps the head between his fingers and thumb and rotates the occiput forwards. But it will be observed also that with his other hand placed over the

uterus externally he pulls round the anterior shoulder so as to bring about a rotation of the trunk. It is essential that the trunk should be rotated, otherwise the head will slip back into its former position whenever the hand is removed; besides, injury may be done to the neck of the child if the head is twisted round while the position of the body is unaltered. Having rotated the head and trunk forwards, the operator should now apply forceps and extract the child very carefully.

Method B.—In this method (Fig. 154) the operator's internal hand, as shown in the illustration, is passed up beyond the head and placed on the shoulder—the trunk is rotated by the internal and external hands. This manœuvre is a little more complicated and is generally reserved for cases in which the simpler procedure (Method A) has failed owing to fixation of shoulders.

The two manœuvres just described may appear simple, but, as a

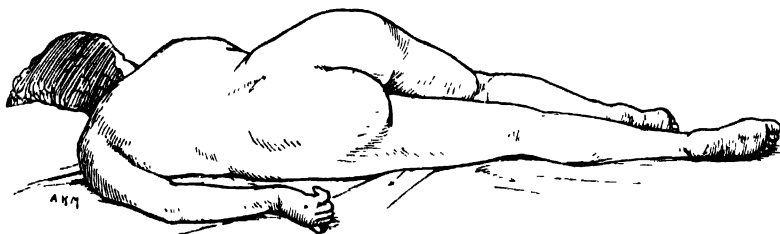


FIG. 155.—Sims' Semi-prone or Exaggerated Left Lateral Position. Very useful in Manual Correction of Unfavourable Presentations. If the patient is fixed up in the lithotomy position, she can be swung over into the left or right lateral position by the assistant.

matter of fact, in practice they are not so easily carried out unless the accoucheur has had considerable obstetric experience.

We have found both methods of rectification difficult to carry out if the uterus is firmly retracted and the patient is in the dorsal position. But if the patient is deeply anæsthetised and placed in the exaggerated lateral position (Fig. 155) rectification is simplified, and for two reasons—firstly, it permits an easy dislodgment of the head because the trunk falls toward the more dependent side; secondly, it encourages rotation of the trunk, provided the patient is placed in the exaggerated left lateral position for a third vertex and the exaggerated right lateral position for a fourth vertex. We have frequently failed to bring about a rotation with the patient in the dorsal position and succeeded quite easily when she has been placed in the most suitable exaggerated lateral position (*vide* subscription to Fig. 155).

After correction of the position by the manœuvres described the patient should be quietly turned round into the dorsal position and forceps applied. Extraction can then be easily accomplished.

Rotation by Means of Forceps.—While this method of rotation may be safe in skilled hands we do not advocate it. Particularly

dangerous is its employment if the back of the child is markedly posterior—in such circumstances the back must be brought forwards manually. To turn the head round with forceps, as one does a key in a door, without at the same time rotating the trunk is a most dangerous procedure for the child. Reference is made elsewhere (p. 703) to a special forceps designed by Kielland and favoured by some obstetricians.

Where manual reposition is impossible and the child has to be delivered with the foetal head in an occipito-posterior position or “face to pubes,” forceps, in the manner described (p. 712), is necessary. In this event “episiotomy” is often of advantage.

There remain a few cases in which the head cannot be extracted with forceps: then the only alternative may be craniotomy, as Cæsarean section in the circumstances might involve subjecting the mother to too great a risk (p. 532). To select Cæsarean section at an earlier stage is only justifiable if there is well-marked pelvic deformity—an occipito-posterior position *per se* does not justify Cæsarean section.

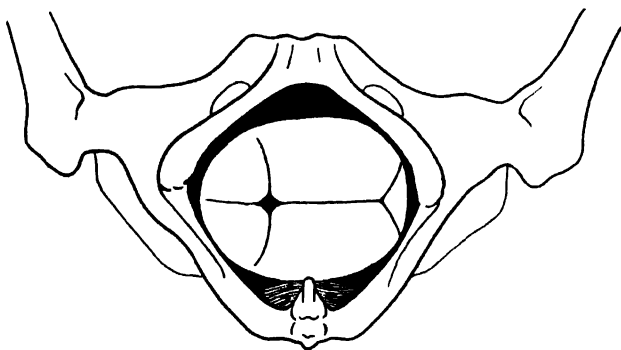


FIG. 156. -Deep Transverse Arrest.

DEEP TRANSVERSE ARREST OF HEAD

This very unfavourable position of the head at the pelvic outlet results from (a) a persistence of the ordinary position assumed by the head prior to labour (p. 510); (b) failure of the vertex in an occipito-posterior position to completely rotate. It is caused almost always by some minor variation of pelvic formation, and more particularly a flattening of the curve of the sacrum (p. 511), or the *android* type of pelvis (p. 537). Before the head can be extracted with forceps the occiput must be rotated forwards, and in certain circumstances this may be extremely difficult and on occasions is impossible (p. 537). We caution our readers to be on the lookout for this condition. If the radiograph shows a pelvic malformation such as has been mentioned as causing this condition, Cæsarean section should be given most serious consideration.

FACE PRESENTATIONS

The frequency of face presentation is 1 in 250-300 births. It is less favourable than the occipito-posterior position already described.

Ætiology.—This presentation may be (a) *primary*—that is to say, it may exist for some time before labour starts; (b) *secondary*, when it develops during the course of labour. Prior to labour face and vertex may alternate. The majority of examples of secondary face presentations develop from occipito-posterior positions of vertex.

The most important causative factor of presentations of the face, be they primary or secondary, is anything which interferes with the sinking down and engagement of the vertex. Therefore they are definitely favoured by (1) slighter degrees of pelvic deformity; (2) obliquity of the uterus; (3) elongation of the foetal head (dolichocephalic); (4) anything which causes the trunk to be less flexed and

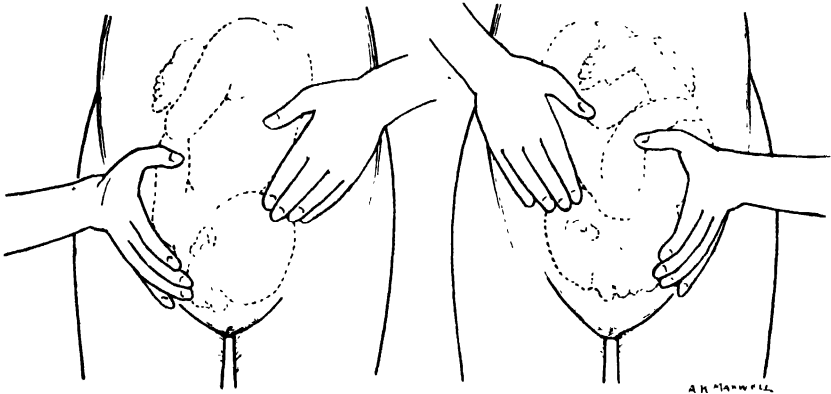


FIG. 157.—Palpation of Head in Face Presentations. Left-hand Figure a Mento-posterior Position (first).—R.M.P. Right-hand Figure a Mento-anterior (third).—L.M.A.

so favours *deflexion* of the trunk or head. Another important cause is (5) malformation of foetus (congenital bronchocele, meningocele, anencephaly)—*malformations are present in 10 to 12 per cent. of all face and brow presentations.*

Diagnosis.—*Palpation.*—The most striking feature on abdominal palpation is a depression between the occiput and back of the child. This, however, is not always easy to determine, and is especially difficult if the back of the child is directed posteriorly. In not a few instances of face presentation the lower pole of the uterus is very sensitive and the foetal parts are consequently difficult to define; besides, the back, as it runs nearer the middle of the uterus, cannot be so easily felt. In this presentation the hand directed towards the chin can be sunk deeper down than the hand which palpates the occiput (Fig. 157). But here again difficulty may be experienced, so that

even the skilled accoucheur, after careful palpation, may overlook a face presentation. A radiograph is of invaluable assistance. It is hardly necessary to add that the breech is found at the fundus, and the limbs are disposed as in vertex presentations. Here the limbs

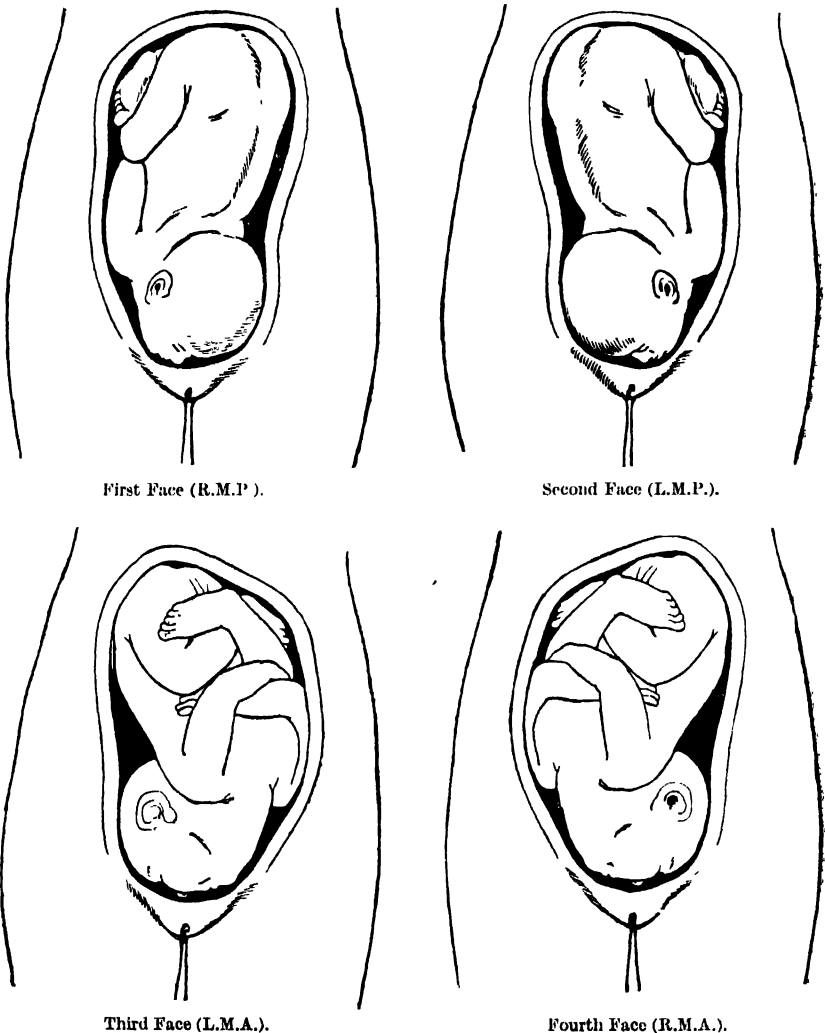


FIG. 158.—Face Presentations.

are particularly easily felt in third and fourth positions in which the thorax is pushed forwards.

Auscultation.—In cases where the chin is directed forwards (mento-anterior positions) the foetal heart-sounds are heard over the chest, which is pressed against the anterior uterine wall. As a matter of fact, the foetal heart-beats can occasionally be felt if the uterine and abdominal walls are thin. But if the back of the child is turned towards

the front (mento-posterior positions) there may be difficulty in hearing the heart-sounds because the back, as already stated, runs more in the middle line of the uterus. Still, in most face presentations the sounds can be heard to one or other side of the abdomen below the umbilicus.

Vaginal Examination.—This examination is of special importance because, as already indicated, the accoucheur is uncertain, in many cases, from his abdominal examination if the presentation is vertex or face. The “landmarks” of the face are characteristic: they are the orbital ridges, the eyes, the bridge of the nose, the anterior nares, the mouth and the chin—particularly important are the anterior nares and the alveolar processes inside the mouth. In practice, however, it is sometimes not easy to feel them, because the presenting part is high, and further, they sometimes resemble quite closely the “landmarks” characteristic of the breech (*vide* p. 459). Should the accoucheur be uncertain regarding the presentation he should anæsthetise the patient. It is infinitely better to put the patient to the slight inconvenience of a short anæsthesia than to remain in doubt as to the presentation. If the patient is in hospital a radiograph should be taken.

Mechanism of Birth.—There are four positions of the face and these are *very easily remembered, for they correspond to the vertex positions, only the head is extended instead of flexed* (Fig. 158). The denominator in face presentations is the chin (mentum). *First face position* (R.M.P.)—long axis of the face is in the right oblique diameter with the chin posterior. *Second face position* (L.M.P.)—long axis of the face is in the left oblique diameter with the chin posterior. *Third face position* (L.M.A.)—long axis of the face is in the right oblique diameter with the chin anterior. *Fourth face position* (R.M.A.)—long axis of the face is in the left oblique diameter with the chin anterior. Thus there are two positions in which the chin is anterior (third and fourth), and two in which it is posterior (first and second).

MENTO-ANTERIOR POSITIONS (THIRD AND FOURTH POSITIONS).—These positions are the most favourable and fortunately occur six times as often as mento-posterior positions. The mechanism is simple if the mechanism for normal vertex positions is remembered. The difference really consists in the substitution of extension for flexion in the early stage, and flexion for extension in the later stage of the labour.

In these positions the head starts its descent in an attitude of extension, and this is increased owing to the resistance of the pelvic canal. Thus we speak of the first movement as one of *extension*. As the head descends in this attitude and meets with the resistance of the pelvic floor the chin rotates forwards, so that the long axis of the face *rotates into the conjugate* diameter of the pelvis, with the chin to the front. This is the second movement, and is exactly similar to and produced by the same causes as bring about this rotation in vertex

positions. As the face comes to the outlet of the pelvis, the chin is seen to be driven under the arch of the pubes, and the face, and finally the occiput, pass over the perineum (Fig. 159). Thus in a face presentation the actual birth takes place by a movement of *flexion*, and

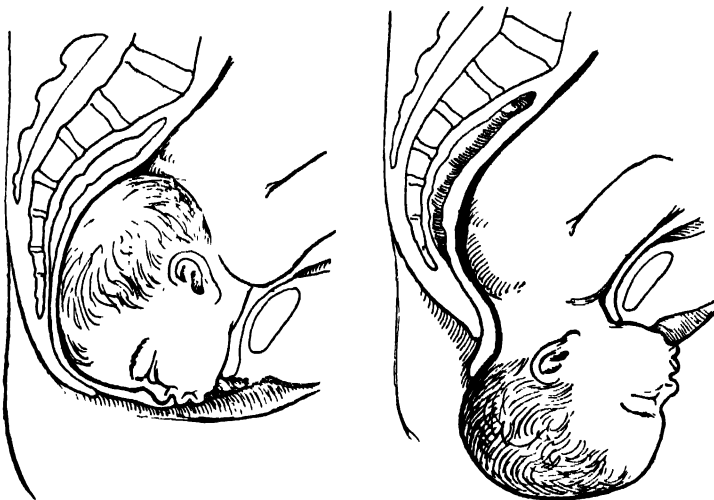


FIG. 159.—Mechanism of Birth in a Mento-anterior Position.

this occurs from the same causes as bring about the birth of the head by extension in vertex presentations. The last movement the face undergoes is an *external rotation* brought about by the rotation of the shoulders as they engage and descend in the pelvic cavity. Here again

this movement is similar to the external rotation in vertex presentations.

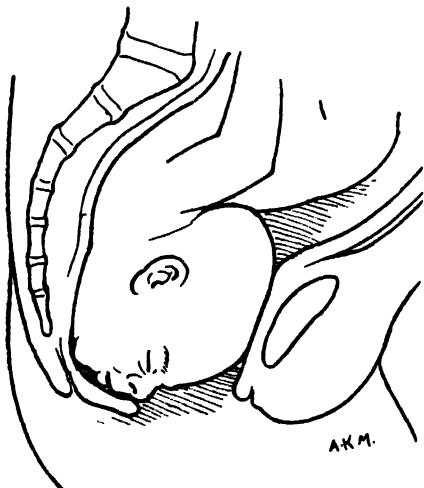


FIG. 160.—Persistent Mento-posterior Position.

MENTO - POSTERIOR POSITIONS (FIRST AND SECOND POSITIONS).—These are comparable to the occipito-posterior positions of the vertex. As the face descends it may take the *long rotation*, in which extension becomes more marked and the chin rotates forwards (in the first through a fourth, and in the second through a third) until it comes behind the symphysis pubis.

Thus it will be observed that the movement is exactly comparable to the long rotation observed in occipito-posterior positions. This is the most favourable termination.

Unfortunately, *short rotation* sometimes occurs. Here the chin rotates into the hollow of the sacrum, a condition known as "persistent mento-posterior position" (Fig. 160). This is a most unfavourable occurrence, because the head, already extremely extended, with the chin behind, cannot be delivered. Even with forceps the occiput cannot be pulled down from behind the symphysis pubis, nor can the chin be pulled over the perineum. Consequently, unless the face is converted into a vertex position or the chin rotated to the front, the operation of Cæsarean section or craniotomy will have to be performed. The latter operation should never be necessary if the malposition has been recognised early enough and the child is alive.

SUMMARY OF MENTO-POSTERIOR POSITIONS

FIRST FACE

Long Rotation

Face right oblique mento-posterior.
Extension.
Rotation into "fourth face"
(R.M.A.).
Rotation into conjugate.
Flexion, with birth of head.
External rotation.

SECOND FACE

Face left oblique mento-posterior.
Extension.
Rotation into "third face"
(L.M.A.).
Rotation into conjugate.
Flexion, with birth of head.
External rotation.

Short Rotation

Chin passes into hollow of sacrum (persistent mento-posterior position).
Head becomes fixed. Birth impossible.

The Caput Succedaneum and Moulding in Face Presentations.—The caput succedaneum in face presentations forms

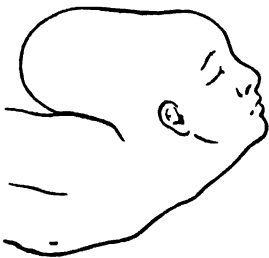


FIG. 161.—Moulding of Head and Attitude of Extension of Head after Birth.

over the malar bones and round the angles of the eyes and mouth. The result is that the child born in this position presents a bruised appearance, somewhat alarming to the mother. The bruising, however, provided no injury has been done to the child, soon disappears, and in a day or two is entirely gone,



FIG. 162.—Showing Edema of Face.

The moulding which occurs is typical (Figs. 161. 162). There is great elongation of the head, which may persist for a few days. Very frequently, also, if the child is placed in bed it will be observed that the head assumes the attitude of extension, which it occupied during its passage through the canal. This is only temporary, however, for

in a day or two the overstretching of the anterior muscles and the spasmodic contractions of the posterior muscles of the neck disappear.

Prognosis.—The prognosis in face presentations varies with the position. Mento-anterior positions are little worse than occipito-anterior positions of the vertex. When, however, the chin is posterior the outlook is distinctly less favourable, because of the uncertainty as to whether or not a long rotation forwards of the chin will occur, or be possible by artificial means. Thus face presentations give the accoucheur a certain amount of anxiety, added to which is the fact that the delicate structures of the face, especially the eyes and mouth and the overstretched sternomastoid muscles, may very easily be injured if the manipulations and delivery are not carried out with great gentleness and care. In all series of presentations of face the foetal mortality rate is high. *In 10 to 12 per cent. of face and brow presentations the foetus is malformed* (p. 449).

Treatment of Face Presentations.—(a) *Mento-anterior Positions.*—Mento-anterior positions should be left severely alone; no attempt should be made to alter them, for in most cases spontaneous delivery occurs. Should this not take place the child can be easily extracted with forceps. Details as to the use of forceps in this condition are described under Forceps Delivery (p. 713).

(b) *Mento-posterior Positions.*—Here the treatment is not so obvious, nor is there general agreement regarding the best course to pursue. This is evidenced by the fact that some specialists recommend version and the bringing down of a foot. There is much to be said in favour of this procedure and it is probably the best choice for the family practitioner faced with this complication, provided he recognises it early enough. But to perform version for an impacted mento-posterior position late in labour is a most dangerous procedure (*vide* Rupture of Uterus, p. 600).

Artificial conversion of a face into a vertex by manipulation is not easy and is impossible if the uterus has firmly retracted on the child. Therefore it should be carried out early in the second stage. There have been many recommendations since Baudelocque first described his method of bringing down the occiput and flexing the head. The one most favoured is to dislodge the head from the pelvis with a hand passed into the vagina. The hand is carried up well into the uterus and pressed against the chest to bring about flexion of the trunk. *This flexing of the trunk is essential to the success of the manœuvre*, and is facilitated by an assistant pulling externally the breech over in the opposite direction. The trunk being well flexed, the operator slowly withdraws his hand, and as he does so he flexes the head. If he has been successful he has secured (a) a flexed trunk and (b) a flexed head *in an occipito-anterior position*. Should this have been accomplished, forceps are applied and the child extracted. The

manipulations are rather complicated and should not be attempted except by an experienced obstetric operator.

It is obvious that we must have some alternative manœuvre than the one described, which, as stated, is difficult and seldom successful if labour is far advanced in the second stage. The *alternative treatment consists in rotating the chin forwards and bringing about a mento-anterior position of the face*. This is generally possible just as in the occipito-posterior positions of the vertex. It should be carried out in the same way. The patient should be deeply anæsthetised and placed in the exaggerated lateral position (p. 447); one hand introduced into the vagina grasps the head and rotates the chin forwards, while the external hand pulls the anterior shoulder forwards. Where there is difficulty in carrying out this procedure the operator should dislodge the head and pass the hand into the uterus beyond the head, and, pressing on the anterior shoulder, push it forwards in the same manner as has been recommended for occipito-posterior positions of the vertex (Fig. 154, B). These manipulations are practically always possible, provided the uterus is not too firmly retracted, and the patient is deeply anæsthetised. Should they fail, however, and craniotomy appear to be the only procedure left to the accoucheur, one other trial should be made to bring about rotation. In mento-posterior positions low in pelvis, where conditions appear hopeless and craniotomy seems the only means of terminating the delivery, a number of experienced accoucheurs have found that the application of forceps and gentle traction on the head has resulted in rotation of the chin forwards. Although it takes place relatively seldom it should always be tried before the *dernier ressort* of craniotomy; but on the strict understanding that traction must not be continued if rotation does not occur.

We are not prepared to recommend Cæsarean section for this condition *per se*. We believe the obstetrician of experience can effect delivery by the vagina satisfactory to both mother and child, provided he chooses the most suitable time for correcting the malposition. But in cases where this opportunity has passed and the head is impacted with the chin posterior, and manual correction has failed, Cæsarean section must of necessity show poor results for both mother and child.

If, however, pelvic deformity exists or a large child and a definite mento-posterior position is recognised before any attempts at correction have been made, Cæsarean section should certainly be considered very seriously. Here a radiograph of maternal pelvis and foetal head is of invaluable assistance. Pelvic malformation may indicate Cæsarean section while foetal malformation (10 to 12 per cent.) would suggest craniotomy as the choice. All this goes to prove once again the advantages of aiming at exactness in diagnosis before or early in labour.

BROW PRESENTATION

This is the most unfavourable position of the vertex, as the longest axis of the head—the occipito-mental diameter—becomes arrested above the pelvic brim. The position is one midway between vertex

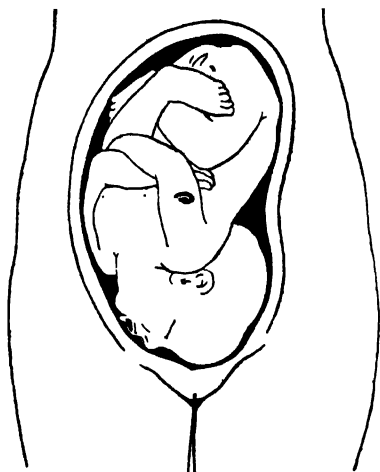


FIG. 163.—Brow Presentation.

and face, as shown in the accompanying illustration (Fig. 163). Fortunately it is a rare occurrence; it is encountered once in 3000 cases. Because of its rarity, and the difficulties experienced in defining the landmarks of the presenting part, the condition is often unrecognised until labour is well advanced. Indeed, in most cases seen by the specialist in hospital, labour has continued for a long time, and unsuccessful attempts at delivery with forceps have generally been made. We would therefore draw the attention of our readers to the diagnosis of this most unfavour-

able presentation and emphasise once again the importance of determining the presentation. In most cases it is advisable to transfer the patient to an institution.

Diagnosis.—By *abdominal palpation* the presentation more closely resembles a face than a vertex, but *owing to the fact that the forepart of head becomes comparatively early fixed in the pelvic brim one is apt to be deceived into thinking that the condition is quite satisfactory.* In this presentation the resistance of chin and occiput is encountered at the same level (compare Fig. 157).

On vaginal examination the “landmarks” felt are the frontal eminence, the orbital ridges, and very generally the bridge of the nose and the anterior nares. But the mouth, alveolar processes and chin can only be distinguished if the examining fingers are passed well up beyond the nose. If the labour has been in progress for some time the “landmarks” referred to are very much masked by the oedematous condition of the forehead and face.

Treatment.—In brow presentation, if the foetus is of normal size and the pelvic canal of normal capacity, the child cannot be born. The brow becomes impacted and the head undergoes the peculiar moulding shown in the accompanying illustration (Fig. 164). It will be observed that the brow becomes unduly prominent or the head assumes a triangular shape.

In a few cases the child has been dragged out with forceps, where great force has been employed; but the injuries done to it and to the

mother never justify such a procedure. The head, therefore, must be converted either into a face or vertex presentation. Under no circumstances should extreme force be employed to deliver the child with the brow presenting. As to which conversion (face or vertex) is preferable, this depends partly upon the position, but chiefly upon which is easier, for sometimes it is easier to bring the vertex, and at other times the face, to present. Generally, it is better to convert into an occipito-anterior position of the vertex or into a mento-anterior position of the face; consequently, if the chin is posterior the vertex conversion is better, while if the chin is anterior, a face conversion is preferable.

As an alternative, *version* may be selected for both mento-anterior and mento-posterior positions.

A number of successes have been secured by the employment of Willett's forceps (p. 581), so useful in certain cases of placenta prævia.

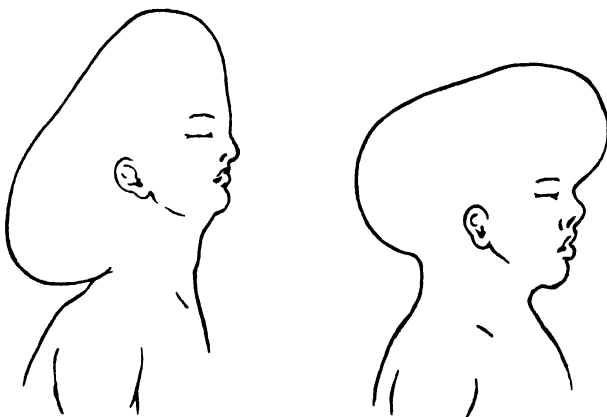


FIG. 164.—Moulding of Head in Brow Presentation. (Spiegelberg.)

The forceps is applied to the scalp over the occiput—a small roll of gauze is passed through the handle of the forceps and a weight (2 lbs.) is attached to the end of the gauze. The traction thus induced brings about flexion of the head—it is a most ingenious procedure.

Here again the question of Cæsarean section may have to be considered in circumstances such as have been outlined in connection with presentations of the face.

PROLAPSE OF ARM WITH CRANIAL PRESENTATIONS

This complication is not common (Fig. 165). It is very important, however, that its significance should be appreciated, for the accoucheur is apt, should he feel a hand or arm at the brim of the pelvis, to conclude that he has to deal with an oblique or transverse presentation (p. 475), and to proceed immediately to perform the operation of version. Now, with a prolapsed arm in front of the head it is not necessary to perform

version. The correct treatment is to push up the arm beyond the head and allow the head to engage. In this condition the head cannot enter the pelvis while the arm is prolapsed; but if the arm is replaced, provided the pelvis is normal, the head enters the brim quite satisfactorily and descends in the ordinary manner. This, however, has to be remembered, that in a large proportion of cases of prolapse of arm the pelvis is contracted. Indeed such a condition should always be suspected where the arm prolapses, and should be given due consideration.

A very rare and particularly complicated condition (Fig. 166) is *nuchal displacement of the arm*, where the arm gets behind the occiput.

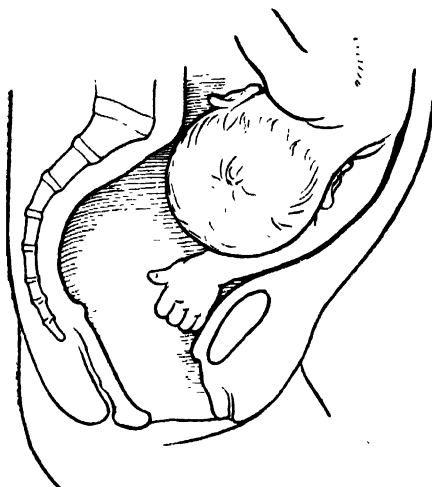


FIG. 165.—Prolapse of Arm with Vertex Presentation.

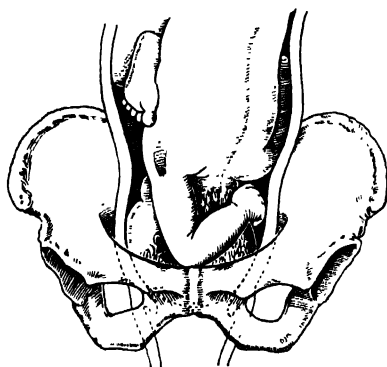


FIG. 166.—Dorsal or Nuchal Displacement of the Arm.

Here the head sinks well down in the pelvis, but is arrested at the outlet. It is specially difficult to recognise, but it should be suspected if there is difficulty in delivering the head with forceps where position of head and pelvic outlet are normal.

The correct treatment is to anæsthetise the patient, place her in the left lateral position, dislodge the head, and push up the arm from the back towards the ventral aspect of the child. Forceps should then be applied and the child delivered.

PELVIC PRESENTATIONS

Pelvic presentations include those of the *breech*, *foot* and *knee*; but, as the two latter are simply presentations of the breech in which the lower limb has prolapsed, they are of no great significance. They will, however, be referred to when we have considered breech presentations.

The frequency of pelvic presentations is about 3 or 4 per cent., taking into account full-time and premature labours, but is only about 2·5 per cent. for labours at term.

Ætiology.—Certain conditions favour the occurrence of pelvic presentation. Amongst the more important may be mentioned: (1) Contracted pelvis—here the deformity of the pelvis interferes with the engagement of the head. (2) Overdistension of the uterus from hydramnios, associated not infrequently with a small foetus—this permits greater mobility of the foetus *in utero* and consequently favours a breech presentation. (3) Plural pregnancy. In a considerable proportion of cases, as we shall see later (p. 496), one or both foetuses presents by the breech. (4) Deformities of the foetus, as, for example, hydrocephalus. (5) Death or prematurity of the foetus. (6) Placenta prævia—breech presentations are relatively more common with this complication because the placenta situated in the lower part of the uterus alters to some extent the shape of the uterus. Besides, in this complication labour frequently comes on before term, and, as stated, prematurity favours breech presentation. (7) Individual peculiarities—occasionally breech presentation recurs in subsequent labours.

Diagnosis.—It is of very great importance that the attendant should recognise a breech presentation not only early in labour, but, if possible, in the later weeks of pregnancy, when the presentation can be altered by external version into the more favourable one of the vertex.

The pregnant woman in whom the foetus presents by the breech complains not infrequently of discomfort in the upper part of the abdomen—for example, she states that she feels a hard body pressing on her stomach, or that she has pain, or that she has great discomfort about the region of the stomach when the foetus moves. While such symptoms are not pathognomonic of a breech presentation they should certainly arouse a suspicion that this condition is present.

We cannot say that we have observed any characteristic difference in the shape of the upper pole of the uterus in breech presentations. But occasionally, in dorso-posterior positions, there may be an undue prominence of the uterus over the fundus where the head is situated. Sometimes, too, a sulcus is observed between the upper and lower pole of the uterus.

Palpation.—The diagnosis of this presentation in the later weeks of pregnancy is generally possible by careful palpation. By this examination the foetal part at the pelvic brim is felt to be softer, less regular and globular, than the hard head. The foetal part at the fundus, on the other hand, is felt to be hard, round and smooth. Sometimes the patient complains of pain on palpation over the head. At the fundus there is another most important sign—namely, “ballottement” of the head between the palpating hands (Fig. 167).

We emphasise this most valuable sign because it is frequently the first to arrest attention during the examination. In most cases it can be made out comparatively easily; but where the liquor amnii is scanty, the head is well flexed and the trunk dorso-anterior, it is more difficult.

The back and limbs of the child are felt to either side of the uterus. The back can be traced down into the breech as a continuous unbroken curved line; but upwards towards the head there may be a slight break and the occiput may be felt if the head is not flexed. Where the dorsum of the child is posterior the limbs are felt in front.

In respect to palpation it will be found in practice that the two conditions which most closely resemble one another—and are therefore most difficult to differentiate—are a dorso-posterior

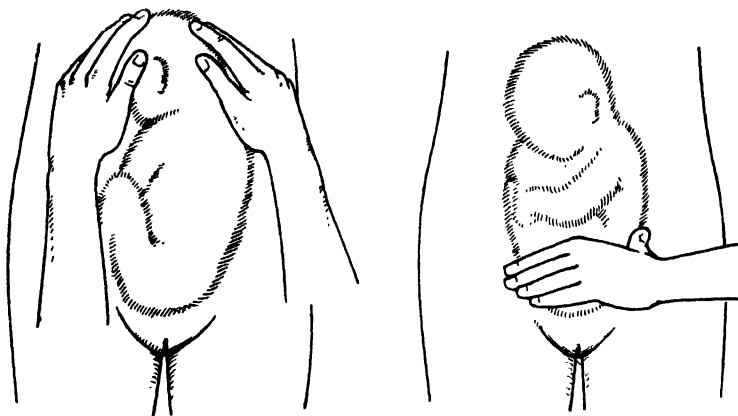


FIG. 167.—Palpation of a Breech Presentation.

position of the breech and an occipito-posterior position of the vertex.

Auscultation.—Another important diagnostic sign of breech presentation is the hearing of foetal heart-sounds most distinctly above the umbilicus, the reason being, of course, that the upper part of the trunk is high in the uterus (*vide* Fig. 81).

Radiography.—In cases in which, after careful examination, there is still uncertainty regarding the presentation a radiograph should be taken in the thirty-seventh week of pregnancy. Even the most experienced obstetrician may find this necessary, and especially if the patient is a primigravida and the abdominal walls are very rigid. There is a further advantage—by radiography it can be determined beforehand if the legs are extended.

Vaginal Examination.—Very little can be made out by vaginal examination before labour, for the presenting part is high and the outline of the breech difficult to define through the vaginal vault.

When labour is well established, and a finger can be passed through the cervix, the softness and irregularity of the presenting surface should arrest attention. It is generally stated that in this presentation the bag of membranes is more *sausage-shaped*; we cannot say that this can always be observed. But there is one very suspicious and not infrequent occurrence—viz., *premature rupture of the membranes*. This may take place very early in labour, sometimes before it has properly started; the occurrence should always lead the accoucheur to suspect a breech or some other abnormal presentation.

Whenever the breech can be reached with ease the different “landmarks” characteristic of it are readily felt. These are the bony tuberosities of the ischia, between which is a depression passing forwards to the genitalia and backwards to the *all-important* “landmark” of this presentation—viz., the rough surface of the sacrum and tip of the coccyx. After the membranes have ruptured, and the breech has sunk into the pelvis, these “landmarks” become more distinct.

Still later, as the breech descends into the pelvis and the uterine wall during a contraction compresses the trunk, *meconium is forced out of the anus*. This is a very useful sign, but it occurs relatively late in labour—the presentation should have been diagnosed before its occurrence. Meconium escapes in head and transverse presentations, but only after a prolonged labour and shortly before the death of the child (p. 429). Of no significance is the discharge of meconium-stained liquor amnii, for, as we have already seen, the foetus not infrequently expels small quantities of meconium into the amnionic cavity in the later weeks of gestation.

It will be observed that at each stage from the thirty-sixth week of pregnancy until labour is well advanced certain indications, or “warnings,” inform the accoucheur that a breech presentation exists.

VARIETIES OF BREECH POSITIONS.—The four positions in which the breech may present are shown in the accompanying illustration (Fig. 168). They are very simply arrived at, by placing the child sitting in the pelvic brim so that the long axis of the head corresponds in position to that assumed by the head in vertex presentations. In breech positions the sacrum is the denominator for nomenclature, so that we have:—

- (1) *First Breech* (L.S.A.).—Long (transverse) axis of the breech in the left oblique diameter—sacrum anterior.
- (2) *Second Breech* (R.S.A.).—Long axis in right oblique diameter—sacrum anterior.
- (3) *Third Breech* (R.S.P.).—Long axis in left oblique diameter—sacrum posterior.
- (4) *Fourth Breech* (L.S.P.).—Long axis in right oblique diameter—sacrum posterior.

Thus, as in vertex presentations, we have two dorso-anterior and two dorso-posterior positions, although the breech may not assume a definite position until labour has proceeded some little way.

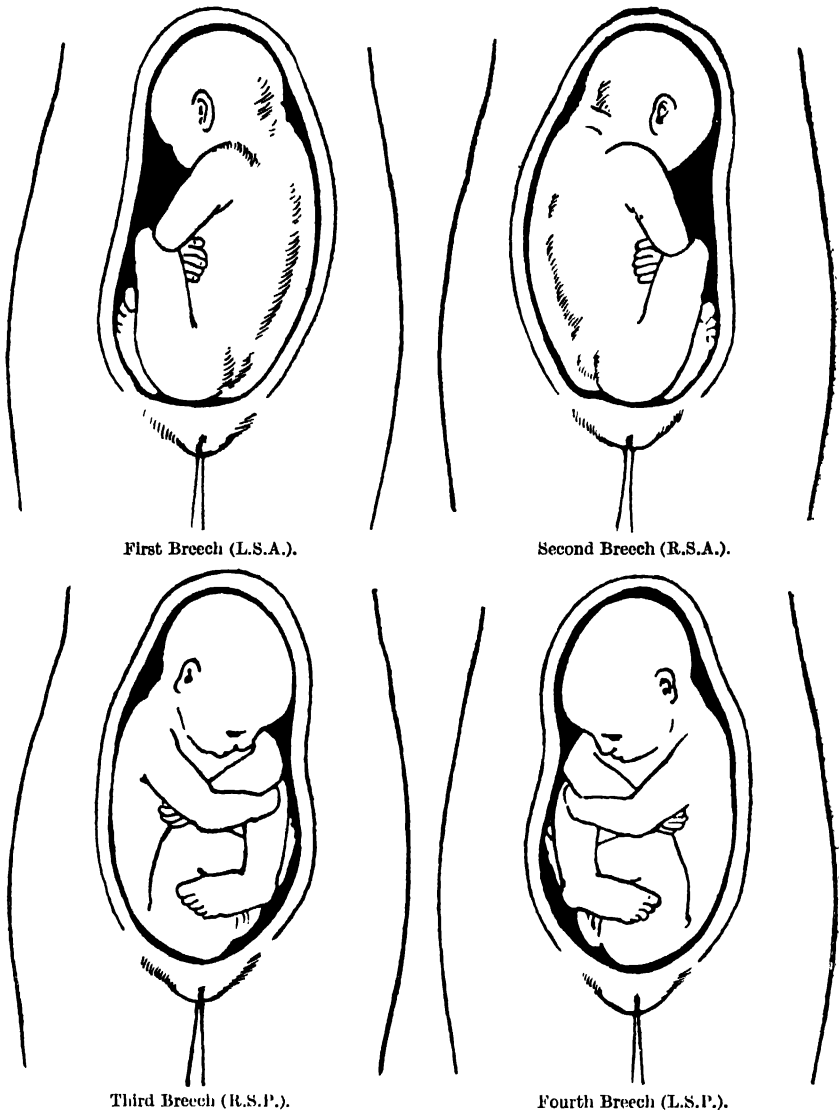


FIG. 168.—Complete or Full Breech Positions. Where the lower limbs are extended the condition is referred to as "Frank Breech."

Mechanism of Birth.—*Dorso-anterior Positions (first and second breech).*—Here the long axis of the breech enters the pelvis in the left (first position) or right oblique diameter (second position) and the sacrum is anterior.

The first movement is : (1) *Descent.*—This takes place as the uterine

contractions force the breech downwards. (2) *Rotation of the Long Axis of the Breech into the Conjugate Diameter*.—This is not so marked as in vertex presentations because the breech is not so bulky as the head. (3) *Lateral Flexion of the Trunk*.—This is well shown in the accompanying illustration (Fig. 169) and is a most important movement. It is comparable to the extension which occurs in vertex presentations and the flexion which takes place in face presentations. As the breech is born it will be seen that the anterior buttock is driven below the symphysis while the posterior sweeps over the perineum. Should lateral flexion not occur the breech is arrested at the pelvic outlet.

The trunk now follows. The shoulders with the arms flexed across

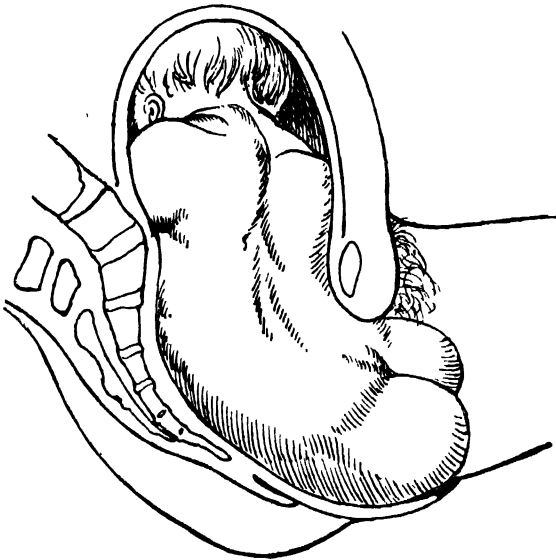


FIG. 169.—Lateral Flexion of Trunk in Birth of Breech.

the upper part of the trunk descend in the same oblique diameter as did the breech. Very often, however, spontaneous delivery of the arms and shoulders does not occur—the arms are held up at the brim and even extended as we shall see.

After the shoulders and arms are delivered the long axis of the head enters the brim in the *opposite oblique diameter to the one occupied by the breech*. The uterine contractions and auxiliary forces fail generally by themselves to drive out the head, because (a) the uterus is so much retracted after expelling the trunk, and (b) the round globular head is not moulded. Consequently in this presentation the assistance of a doctor or nurse is essential if the child is to be saved. Only very occasionally does spontaneous delivery of a live child occur—generally speaking, it only happens if the child is small, the pelvis roomy, and the uterine contractions are unusually strong.

When spontaneous birth does occur the occiput is pressed against

the symphysis pubis, and the chin, face, and brow sweep over the perineum.

Prognosis.—As far as the mother is concerned the prognosis is slightly worse in breech presentations because of the increased risks of infection owing to the more frequent examinations and vaginal manipulations necessary in the delivery. Besides, lacerations of the vulva and lower vagina are more frequent. *As regards the child, the prognosis is very decidedly less favourable, especially in primiparæ.* Indeed, so bad is it in ordinary obstetric practice that the foetal mortality may be as high as 20 to 30 per cent. in primiparæ. This on a conservative estimate is eight or ten times that for vertex presentations.¹

Most of the deaths result from injuries to the tentorium, falx cerebri, and articulations between spinal column and cranium during extraction of the after-coming head, which has to pass through the pelvis rapidly and unmoulded. In addition other injuries may be inflicted, such as fracture of arms, laceration of the brachial plexus with resulting "birth paralysis," injury to sternomastoid muscle, dislocation of lower jaw, etc. (*vide* Chapter XXXV, p. 608).

Management.—PROPHYLACTIC EXTERNAL VERSION IN LATE WEEKS OF PREGNANCY OR EARLY IN LABOUR.—We, in common with other writers, recommend this procedure, not only because when successful it lessens enormously the risks to the child but because it is sound in principle and generally possible in practice. It is possible in almost all multigravidæ and in 70 to 80 per cent. of primigravidæ up to about three weeks before term; but it becomes increasingly difficult, especially in primigravidæ, as full term approaches. It is impossible in plural pregnancy. The manipulations are described under External Version (p. 695). In not a few cases it is necessary to anæsthetise the patient before the head can be swung round and brought to present. *The manipulations must not be carried out too energetically*, because if the placenta is situated on the anterior wall of the uterus, as occurs in 40 per cent. of cases, injury may be done to it and a partial detachment may result. It is well to bear in mind also that prolapse of the cord is a not uncommon sequela. Because of these occurrences more particularly, the foetal death-rate is 2 to 4 per cent. higher where a cranial presentation has been artificially brought about than if it originally existed.

Especially difficult to convert is the "frank breech" in which the legs are extended. Indeed, if there is much difficulty in performing version in the thirty-sixth week this unfavourable attitude of the lower limbs should be suspected; it can always be confirmed by radiography. Naturally, also, a large child and scanty liquor amnii render the operation more difficult.

Having performed external cephalic version the head should

¹ A breech presentation in a primipara is a very serious condition, and the delivery should not be undertaken by anyone with only moderate experience in obstetric practice.

be pushed into the brim, rolls of gamgee placed at the sides of the uterus, and a firm binder applied so as to maintain the foetus in its new presentation.

If the foetus resumes the old presentation this should be again corrected. Repeated corrections are necessary in a relatively small percentage of cases. Where they have to be employed the accoucheur should give instructions that he be summoned to the patient's bedside immediately labour commences, so that he may still have an opportunity of correcting the presentation in case it has again become a breech.

MANAGEMENT OF LABOUR.—We shall see later how special difficulties in connection with this complication should be dealt with. For the present we are concerned only with the management of an ordinary breech presentation.

First Stage.—Little can be done for the patient during this stage beyond interesting her in other matters (p. 418). It is very questionable if it is advisable to keep her in bed in order to preserve the bag of membranes intact as long as possible—unfortunately, as we have already seen, premature rupture of the membranes is a common occurrence. From time to time during labour the foetal heart should be auscultated. As in all labours, the bladder should be kept empty. With this presentation *special caution should be exercised in administering sedatives early in labour.* It is of very great importance that the uterine contractions should in no way be inhibited; and especially that there should be a good pelvic floor reflex as that results in strong bearing-down efforts in the second stage.

Second Stage.—Nature should be given every chance of effecting expulsion of the child, at least as far as the arms. Early traction on the breech, or bringing down a foot and exerting traction on it, disturbs the general attitude of flexion of arms and head and favours extension of both, which adds enormously to the difficulty of completing the delivery. The accoucheur should therefore not interfere until the breech is born.

When the breech is about to pass through the vaginal orifice the patient should be placed in the lithotomy position and the legs supported by leg-rests, (lover's crutch, or leg-straps—the lateral position is not suitable for a breech delivery. The degree of anæsthesia should be about half surgical anæsthesia at this stage.

It is seldom necessary to pull the buttocks through the vaginal orifice (*vide* p. 470), but very often after they are well through a little manipulation is required to free the legs. The expulsion of the breech is aided if the assistant or nurse places one hand over each side of the fundus and *compresses it during a pain.* It serves no purpose if compression is made in the intervals between the pains. The object is to force out, not to drag out, the breech. Naturally, compression must be restrained, not excessive.

Whenever the breech is born a loop of cord should be pulled down to prevent it being dragged on unduly. The trunk may then be wrapped in a warm sterile towel to prevent the child making premature inspiratory efforts, although this is unlikely if the room is well heated.

If there has been steady but moderate suprapubic pressure, and the trunk has not been unduly dragged upon, the arms can be easily brought down because they are still flexed across the chest or, at worst, over the face (Extended Arms, *vide* p. 471). Having raised the trunk slightly by grasping the legs with the right hand, as in Fig. 180, the

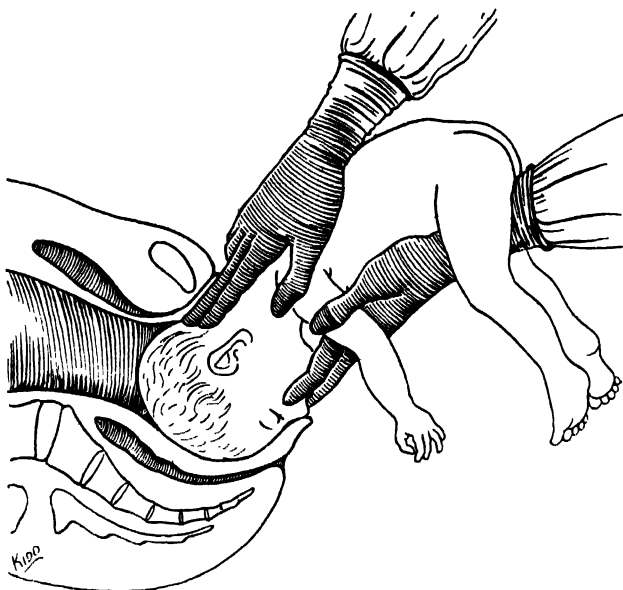


FIG. 170.—Delivery of the After-coming Head (Mauriceau-Smellie-Veit method). Note position of operator's hands—the object is to flex head and make rigid head and trunk. Note also that fingers of left (lower) hand placed over malar bone retract perineum and permit child to make respiratory efforts with safety—thus undue haste in delivery is unnecessary.

accoucheur should pass the fore and middle finger of his left hand—here it is unnecessary to introduce the whole hand—along the back of the child, over the shoulder which is posterior, and bring down the posterior arm. *The posterior arm is selected because there is more room in the hollow of the sacrum to carry out the manipulation.* The arm is pressed down over upper trunk and not simply dragged straight down. The trunk is raised in carrying out this manipulation, to depress the posterior shoulder and so bring the arm more readily within reach (*vide* p. 471).

The bringing down of the anterior arm is very easy if the trunk is now depressed or pulled backwards whilst the internal hand sweeps the anterior arm down.

The simplest method of delivering the head is to raise the child's body (astride of the left arm) towards the mother's abdomen and to make suprapubic pressure on the head with the right hand placed on the fundus. This method is successful if the child is of average size and the maternal pelvis is of normal capacity.

If, however, there should be any difficulty in bringing the head into the pelvic cavity it is safer to employ the method shown in the illustration (Fig. 170). The fore and middle fingers are passed along the side of the face over the malar bones, while the thumb, ring, and little finger are placed round the chest. The right hand grasps the trunk in such a manner that the thumb is placed round the chest and underneath the left shoulder, the ring and little finger over the right shoulder, while the fore and middle fingers press up the occiput. The accoucheur has two objects in view in placing his hands in the manner described : (a) Maintaining flexion of the head ; and (b) fixing as far as possible the trunk and head. A large number of children are lost, not because of delay in delivering the after-coming head, but because the trunk is unduly dragged upon and injury is done to the spinal articulations and medulla. At this stage, *moderate suprapubic pressure* on the head is of great assistance. Having arranged his hands as above described, and flexed and fixed the head, and having instructed his assistant to exert suprapubic pressure, the accoucheur should direct his traction downwards and backwards until the head has passed the brim, and then forwards and upwards towards the mother's abdomen. *He must on no account pull the trunk upwards and forwards before the head is well in the pelvis*, because if he does, extension of the head is produced, delivery is more difficult, and the chances of injuring cervical articulation with cranium and cervical vertebræ increased. Further, he must not extract the head too rapidly through the vulvar orifice, otherwise he may do serious injury to the perineum. In a primipara it is often advisable to perform a deep episiotomy before proceeding to delivery of the head.

An entirely new method has recently been recommended by Burns and Marshall of Liverpool. They allow the child's trunk to hang unsupported—its weight brings the head well into the pelvis. The trunk is then directed upwards as already described.

The manipulations described for the delivery of arms and head must be carried out with alacrity, but quietly and deliberately. The accoucheur must not get excited over the delivery. After the child is born the management of the third stage is as already described.

The child requires special attention, because it is generally asphyxiated. Here we would warn against encouraging respiration before the upper respiratory tract has been cleared of all mucus and blood which otherwise may be drawn into the lungs when the first respiratory effort is made.

COMPLICATIONS IN BREECH PRESENTATIONS

The following require special consideration :—

- (1) Breech arrested at brim.
- (2) Breech arrested at outlet (" impacted " breech).
- (3) Arms extended.
- (4) After-coming head arrested.
- (5) Dorso-posterior position.

(1) **BREECH ARRESTED AT THE BRIM.**—Naturally under this heading we only refer to cases where the breech is arrested after labour has been in progress for a considerable time. This is not a common complication, but it may arise : (a) if the pelvic brim is contracted ; (b) if the child is of undue size ; (c) if there is a tumour of the pelvis, uterus or ovary, preventing its descent ; (d) if there is a tumour of the foetal pelvis, or an abdominal enlargement of the foetus (p. 487).

If the breech is arrested at the brim the maternal pelvis should be carefully examined. (This, of course, should have been done in pregnancy and the attending accoucheur should know the condition of the pelvis.) It is obvious that if the pelvic brim is deformed to only a slight degree difficulty in delivering the child is greatly increased. We are opposed to bringing down a foot if there is an appreciable degree of deformity, and advise Cæsarean section in such cases.

Where the obstruction is a tumour (ovarian or uterine), abdominal section should be performed unless the tumour can be pushed out of the way (*vide* p. 550).

Lastly, where the foetus is deformed by a pelvic tumour or abdominal distension its life need not be considered. The method of dealing with these conditions is considered later (p. 487).

The more ordinary case encountered, however, is where the child is of considerable size. The delivery in this case is effected by bringing down a leg, and the accoucheur should select the anterior leg, for if he brings down the posterior one the anterior buttock catches on the symphysis pubis (Fig. 171).

Having brought down the leg, traction should be exerted on it only if the os is fully dilated ; if the os is not fully dilated labour should be allowed to continue until dilatation is complete. The great objection to exerting traction before the os is completely dilated is that the partially dilated cervix grips the trunk (Fig. 172) and interferes with the bringing down of the arms and head. The further delivery is completed in the manner described later.

(2) **BREECH ARRESTED AT THE OUTLET.**—This is a fairly common complication. It arises (a) where the pelvis is slightly deformed at the outlet ; (b) where the foetus is of unusual size ; (c) where the legs are extended (Fig. 173). Considerable discussion has arisen regarding

this extension of the legs. It is relatively common in primigravidæ. In some cases it is a primary attitude of the limbs ; in others it occurs

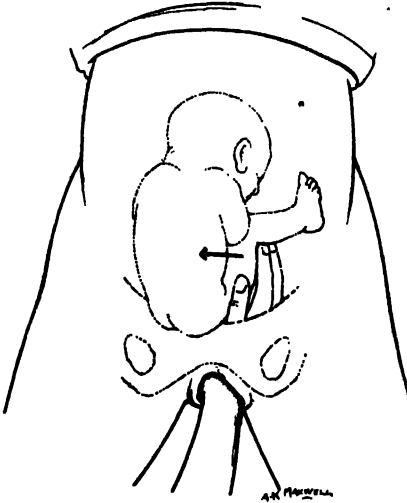


FIG. 171.—Bringing down a Leg. Note the bending of Thigh on Trunk to bring Foot within reach.

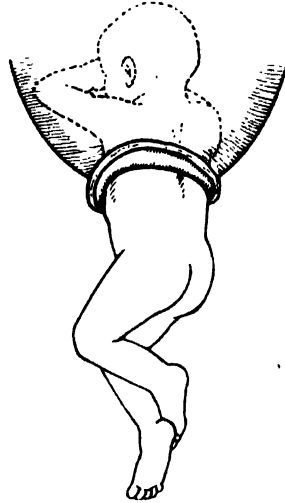


FIG. 172.—Arms caught by Cervical Ring.

during the descent of the trunk, and is favoured by early rupture of the membranes causing undue retraction of Bandl's ring. The limbs so extended act as splints to the trunk, and prevent the lateral movement (Fig. 173) which we have seen is essential to the birth of the breech.

We attach considerable importance to early recognition of extended legs. Sometimes the condition can be diagnosed by abdominal palpation and is always possible from a radiograph. The reason it is so desirable to recognise this unfavourable attitude early is because bringing down a foot early in second stage is a simple matter, whereas when performed late in labour it may be difficult.

Many suggestions have been made for dealing with a breech impacted at outlet. It has been recommended that the fingers should be slipped over the groin (Fig. 174) ; that a loop of gauze should be

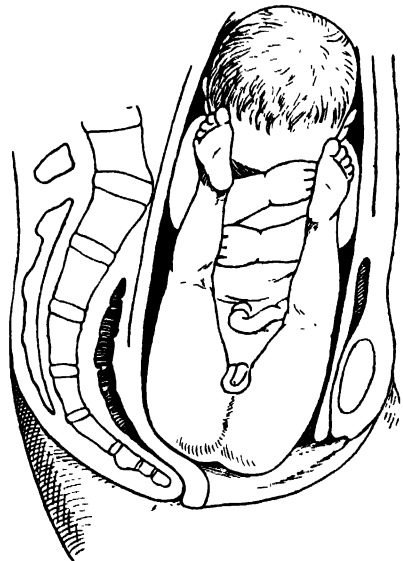


FIG. 173.—Extension of Limbs.

passed over the groin; or that forceps should be applied to the breech. Undoubtedly in some cases these manipulations succeed; but in really difficult cases they generally fail, so that we prefer the following procedure. The patient is placed in the left semi-prone or Sims' position (Fig. 155) and deeply anæsthetised. The idea of

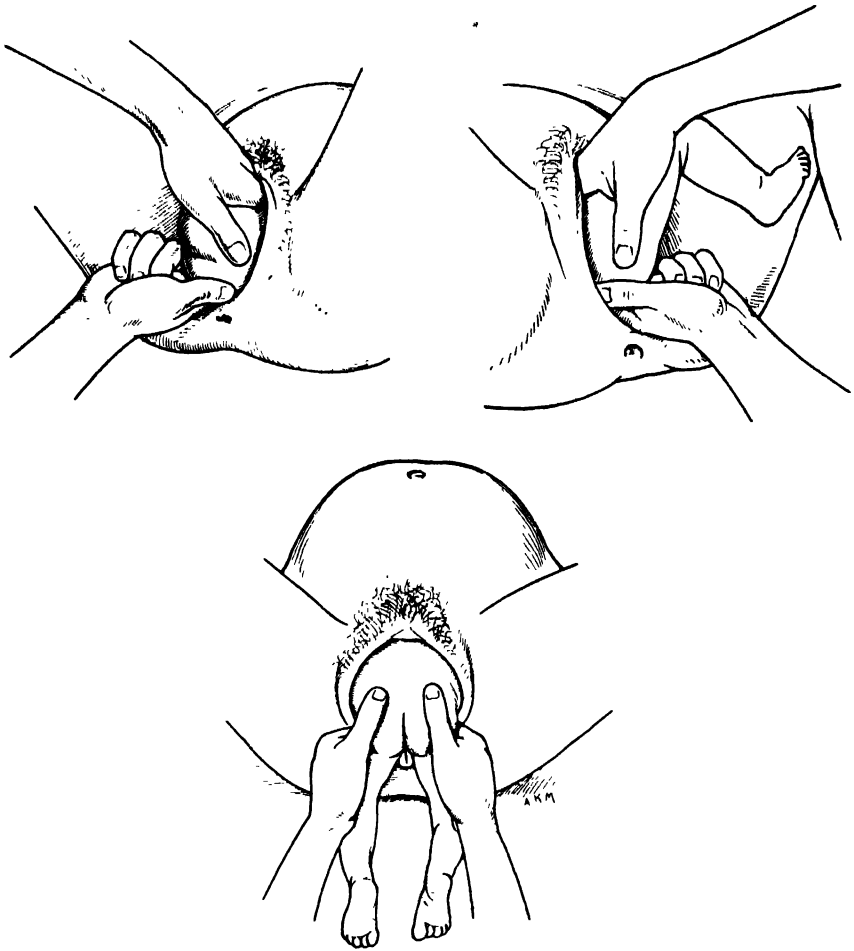


FIG. 174.—Manual Extract of an Impacted Breech. Vagina should be manually stretched or "ironed out" (p. 693) before operation.

placing her in the Sims' position is to allow the breech to be pushed out of the pelvis, and the deep anæsthesia is to remove all reflexes. The accoucheur now passes one hand into the vagina, pushes the breech out of the pelvis, passes his hand along the thigh, and seizes hold of a foot (Fig. 175). The foot having been brought down, traction is exerted upon it, and the breech is pulled through the canal and delivered. The rest of the delivery is completed in the manner already described. This operation is comparatively simple if the

uterus is not too firmly retracted on the child. It sometimes happens, however, that owing to extreme retraction of the uterus there is great difficulty in carrying out the manipulations. Should this be the case the operator has no option but to employ a blunt hook, passed over the fold of the groin Fig. (176). There is always the risk that soft parts and femur may be injured by this manoeuvre, but if carried out carefully the risks are not great, and generally little more than bruising of the parts results. If there is any suspicion of injury having been done to the thigh, or to the upper femoral epiphysis, a radiograph should be taken after the delivery and any injury if present suitably treated.

(3) SHOULDERS AND EXTENDED ARMS.—We have already described how the arms should be brought down. The particular condition we are now concerned with is where the arms slip up along the side of the head (Fig. 177). Here the child should be grasped by the feet, and the trunk directed forwards and upwards. It is advisable not to exert too much traction on the trunk,

otherwise the arm is jammed between the pelvic wall and the head. The fore and middle fingers of the left hand which has been introduced into the vagina should be passed over the shoulder



FIG. 175.—Manner in which Foot is grasped.

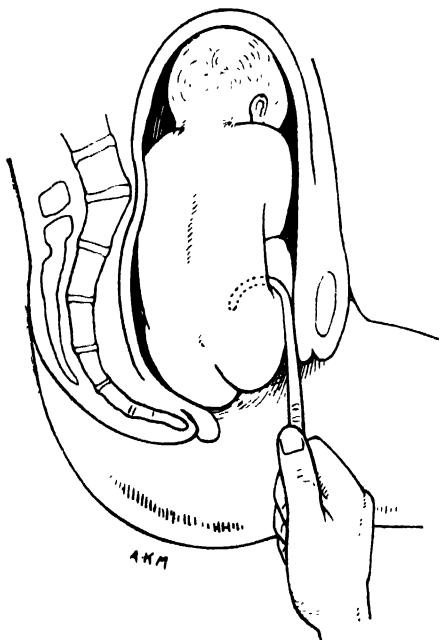


FIG. 176.—Blunt Hook applied for extraction of Breech.

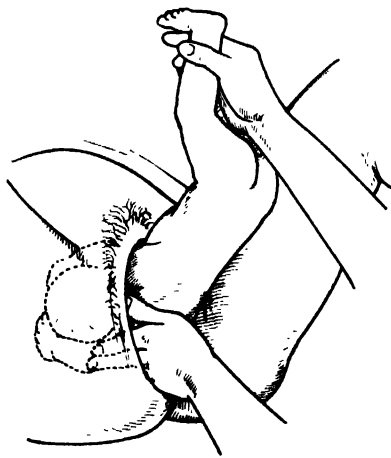


FIG. 177.—Bringing down Posterior Arm when Arms are extended.

and along the arm as far as the elbow, which should then be pushed over the face. It is most important to get the fingers well down the humerus to near the elbow joint, otherwise the humerus may be fractured.

In this as in the simpler condition (p. 466) it is preferable to bring down the posterior arm first, because there is more room for manipulations in the hollow of the sacrum. Having brought down the posterior arm, the trunk should be directed slightly backwards and the accoucheur should pass his right hand up along the dorsum of the child, over the shoulder, and push the anterior arm down over the face. This is sometimes very difficult, consequently some operators prefer to rotate the child's trunk (Fig. 178) and bring the arm which is anterior into a posterior

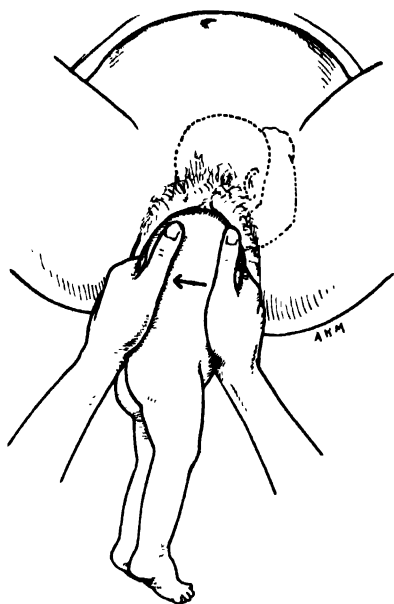


FIG. 178.—Bringing Anterior Arm into a Posterior Position by rotation of Trunk. Arrow indicates direction of rotation.

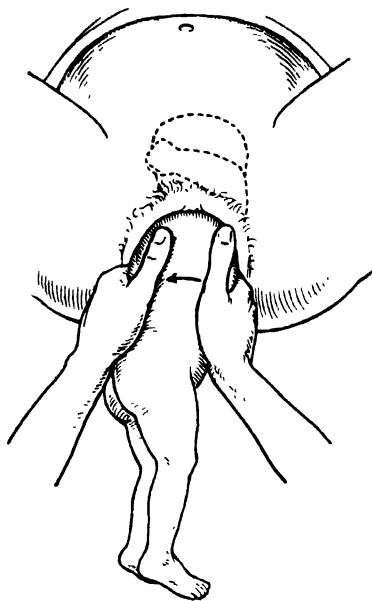


FIG. 179.—Nuchal Displacement of Arm. Arrow indicates direction of rotation.

position in the hollow of the sacrum. This often proves very successful, for in rotating the trunk the resistance offered by the pelvic wall tends to bring the arm more within reach. Naturally, the rotation must be carried out very carefully, the trunk being pushed up and rotated, not simply twisted round. Now there are two directions in which the trunk may be rotated—viz., to the right, or to the left; and if the child is rotated in the wrong direction a worse condition may be produced, for the arm may be brought to lie behind the occiput (nuchal displacement), to be referred to later. The child's trunk should therefore be rotated so that the resistance offered is such that the arm is progressively coming to be more within reach. Very often when it impinges on the promontory of the sacrum the promontory depresses the arm and its liberation is consequently very much simplified.

Nuchal Displacement of the Arm.—A very unfavourable displacement is the nuchal or dorsal displacement of the arm (Fig. 179). In this condition, rotation of the trunk renders delivery of the arm extremely simple, while if it is brought down in the manner ordinarily followed it may be seriously injured. It will be observed that, in the particular case illustrated, the rotation is from left to right, and that the resistance offered by the walls of the parturient canal tends to bring the arm to the side and then in front of the head in the process of rotation.

(4) AFTER-COMING HEAD.—We have already described the ordinary methods of delivering the after-coming head. Many others have

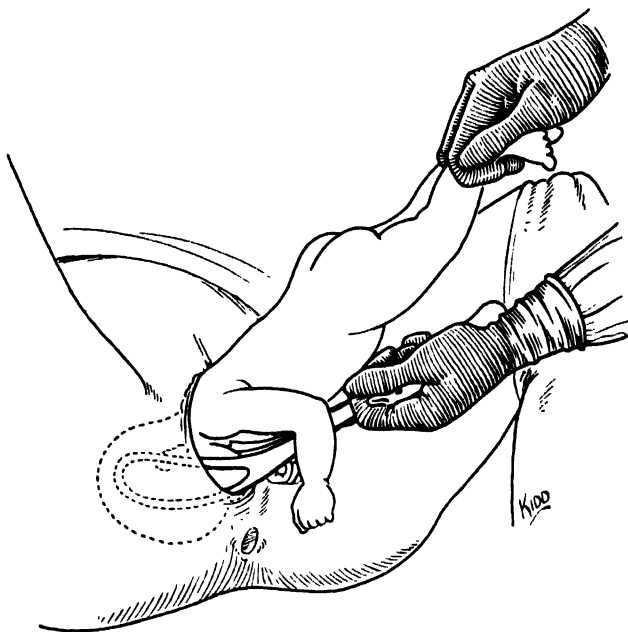


FIG. 180.—Forceps applied to After-coming Head.

been suggested which it is unnecessary to detail here. We are convinced that if the manoeuvres already recommended are not successful the simplest and best way of dealing with the after-coming head is to apply forceps, as shown in the foregoing illustration (Fig. 180). The advantage of forceps in delivering an after-coming head is that the blades fix the head and the trunk and no injury can be done to the articulation between spine and cranium; further, flexion of the head is maintained. We therefore recommend that every one, faced with a breech delivery, should have forceps at hand ready for use in case there should be any special difficulty with the after-coming head. The method of applying the forceps in this condition is described elsewhere (p. 714).

(5) DORSO-POSTERIOR POSITION OF THE BREECH.—The arms are more difficult to bring down, and the after-coming head is more liable to become extended.

It is quite unnecessary that this complication should arise—before the breech has been delivered, and even after it has been

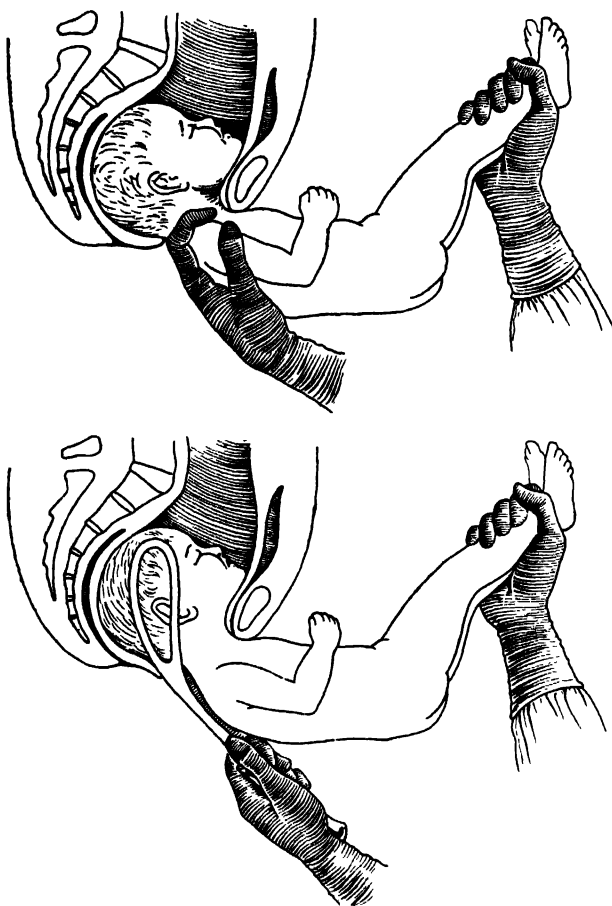


FIG. 181.—The Delivery of the After-coming Head when the Occiput is Posterior. (Prague Method.)

born, the trunk can, and should be rotated, so that the back of the child is directed forward. It is most important, therefore, that these manipulations should be carried out, and that the dorso-posterior position should not be allowed to persist. For cases in which rotation of head is impossible the "Prague" method (Fig. 181) has been recommended; but none of the authors approve of its employment except as a *dernier ressort* and craniotomy is the only alternative.

FOOT AND KNEE PRESENTATIONS

These are simply pelvic presentations in which the foot or knee has prolapsed. The foot may be distinguished from the hand by the presence of the heel. The direction of the heel indicates where the back of the child is placed, and the great toe indicates which foot is prolapsed.

Presentations of the *foot* should be left alone. It is a mistake to drag upon the limb and bring the trunk through the partially dilated cervix, for, as we have seen, this results in the arms and after-coming head being caught by the ring of the cervix (p. 469).

Knee presentations are very rare. The knee resembles the elbow more particularly, but is to be distinguished from it by the presence of two prominences, with a slight depression between. The treatment is to bring down the foot and leave the labour to progress, as already recommended.

SHOULDER PRESENTATION

The term generally employed for this presentation or "lie" is transverse, but, as the child usually lies obliquely, oblique presentation or lie is the more correct. The popular term is "cross-birth." The frequency is, roughly, 1 in 175 births.

Any part of the trunk from the shoulder to the breech may present, but from the fact that an oblique presentation ultimately resolves itself into one of the shoulder it is unnecessary to subdivide it further. The position of the child may be either dorso-anterior or dorso-posterior with the head to either side. Thus there are four oblique presentations, and each one is arrived at by placing the child in the corresponding vertex position, and allowing the head to be displaced towards the side to which the occiput is directed. The denominator is the *Acromion Process*. Thus the *first* oblique presentation is dorso-anterior, head to left, right shoulder presenting (L.A.A., Fig. 182); *second* (R.A.A.) is dorso-anterior, head to right, left shoulder presenting; *third* (R.A.P.) is dorso-posterior, head to right, right shoulder presenting; *fourth* (L.A.P.) is dorso-posterior, head to left, left shoulder presenting. The relative frequency of dorso-anterior to dorso-posterior positions is about 7 to 5.

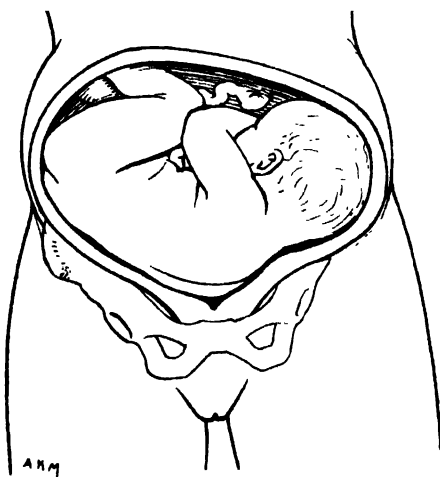


FIG. 182.—Shoulder Presentation.
(First Position.)

Ætiology.—Abnormal maternal conditions play a more important part than foetal abnormalities. Multiparity, a large and flabby uterus, a pendulous abdomen, an overdistended cavity from excessive liquor amnii, plural pregnancy, placenta prævia, and a marked disproportion between the head and the pelvis are the most important causative factors. But there is one other interesting maternal condition which undoubtedly predisposes to this presentation—viz., *uterus cordiformis*, which has been already described and figured (p. 103). This slight malformation, often overlooked, is sometimes the determining factor. Very occasionally, also, tumours of the lower part of the abdomen—ovarian, uterine, or pelvic growths—may interfere with the engage-

ment of the head and thus favour this abnormal presentation. On the part of the child, prematurity, death, and deformity are the most important causes.

Diagnosis.—The diagnosis is comparatively easy in most instances. On looking at the abdomen the uterus is seen to be unduly wide transversely and to present an irregular outline higher to one side than the other. This becomes more marked after rupture of the membranes (Fig. 183). On *palpation* the bulky breech is felt to one side and the round, hard globular head to the other, and the presentation is usually a shoulder, as the head is rather lower than the breech.

On auscultation the foetal heart-sounds are heard below the

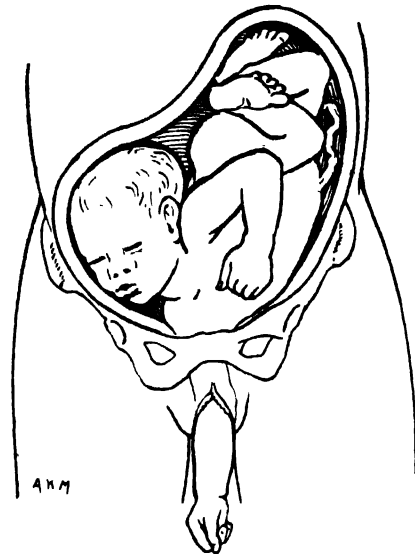


FIG. 183.—Outline of Uterus in Shoulder Presentation after rupture of Membranes and with Arm prolapsed. (Third Position.)

umbilicus, only slightly above the brim of the pelvis, and consequently at a lower level than one usually hears them in vertex presentations.

Vaginal Examination.—The bag of membranes is often elongated and described as “sausage-shaped,” but this, of course, can only be made out when the labour is fairly well advanced. The most striking feature, if the examination is made early in labour, is the *extreme difficulty in reaching and feeling the presenting part*; indeed, it is often only possible under anæsthesia.

As already stated, an oblique presentation ultimately resolves itself into one of the shoulder. This “landmark” can be readily determined by feeling the three ridges running from it (the clavicle, spine of the scapula, and the humerus); but more important as a guide is the presence of the ribs and intercostal spaces in the immediate vicinity.

Frequently an arm slips down at a comparatively early stage. If still high up in the pelvis the hand is to be distinguished from the foot by the absence of the heel; the mobility of the thumb and the length of the fingers as compared to the toes cannot be relied upon. From the position of the prolapsed hand one can determine the position of the foetus, for if the accoucheur can shake hands with his right hand then it is a right foetal arm which is down (Fig. 186), whereas if he can shake hands with his left hand it is the left one which is prolapsed. Further, the thumb points towards the head if the arm is completely pronated. The elbow, which sometimes comes down, is to

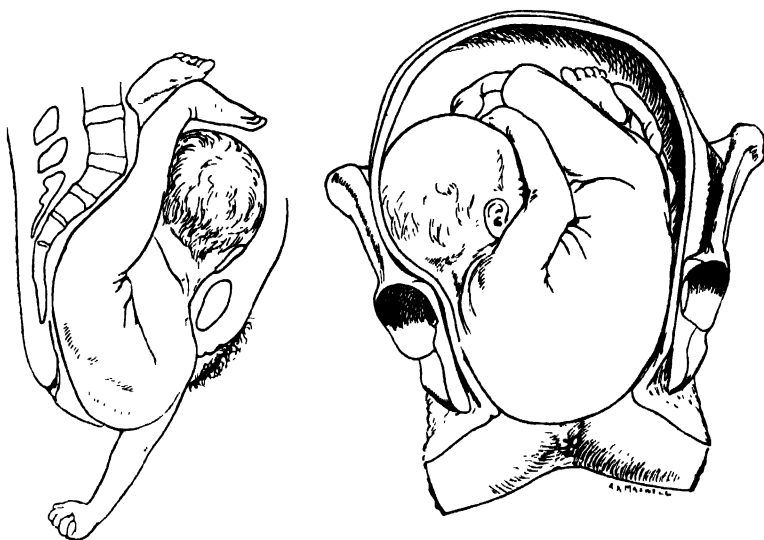


FIG. 184.—Spontaneous Evolution.

FIG. 185.—Partus Corpore Conduciplicato.

These two varieties of spontaneous delivery are extremely rare occurrences (*vide* p. 478).

be distinguished from the knee by the sharp, bony prominence of the olecranon process.

Prognosis.—The prognosis is very bad for the child where manipulation for correction before or early in labour has failed. Where internal version is employed the mortality is 30 to 40 per cent., while of the children born alive many are deeply asphyxiated and not a few have serious cerebral and cervical injuries (p. 614).

Prolapse of the cord is another common occurrence, and one of the causes of the high foetal mortality associated with this presentation.

Mechanism of Labour.—The natural course of labour in an oblique presentation is for the shoulder to become pushed down into the pelvis (impacted shoulder), and, if the malpresentation is not corrected, for the labour to continue until rupture of the uterus occurs or the patient becomes exhausted.

Very occasionally, however, a spontaneous delivery does occur and it may take place in one of the following ways :—

- (a) Spontaneous version.
- (b) Spontaneous evolution.
- (c) Body doubled up (*partus corpore conduplicato*).

(a) *Spontaneous Version*.—The oblique presentation becomes altered into one of head or breech (*vide* Treatment). It occurs frequently before rupture of the membranes but seldom after this has taken place.

(b) *Spontaneous Evolution*.—This termination was first described by Douglas, and is a very rare occurrence. As seen from the illustration (Fig. 184), the arm and shoulder are driven down into the pelvis and become fixed underneath the symphysis pubis, while the trunk, breech and limbs are driven past them. Finally, the other shoulder and head are born. It can only occur where the pelvis is roomy and the child relatively small. Consequently it is most often observed in premature births or where the child is macerated.

(c) *Doubled-up Body (partus corpore conduplicato)*.—As shown in the illustration (Fig. 185), the body is doubled up below the shoulder and driven through the pelvis until the breech and legs escape; the rest of the trunk and head follow. It only happens if the child is very small, premature, or macerated. It is an extremely rare occurrence.

Treatment. — *Prophylactic Version*.—We have repeatedly pointed out the importance of a thorough examination of the patient in the later weeks of pregnancy. At this stage, if the malpresentation is recognised it can almost always be corrected and a vertex substituted.

Very often by simple postural treatment rectification can be effected, for, if the patient is placed on the side towards which the head is directed the weight of the trunk falls over towards that side, and the head in consequence slips into position over the brim of the pelvis.

If postural treatment does not succeed the correction must be carried out by External Version (p. 695).

After correction of the presentation by postural or manual treatment, the head should be pushed into the pelvis and pads and an abdominal binder applied. It will be found that the foetus does not remain in the new position as frequently as it does if the breech has been corrected (p. 464). Therefore the accoucheur should give instructions that he must be informed immediately of the onset of labour.

Management during Labour.—If the condition is recognised early in labour, before the membranes have ruptured, it is often possible to bring about a vertex presentation in the manner already described; but more generally it is difficult, and considerable traction on the trunk upwards and pressure of the head downwards is necessary. In many cases it is only possible if the patient is anæsthetised.

If labour is further advanced, the membranes have ruptured, and

the uterus has retracted over the child, it is not possible to correct the presentation by external version. In such circumstances either bipolar version (p. 696) or internal version must be employed (p. 697).

There remains one type of transverse presentation in which it is extremely dangerous to perform version—viz., *impacted shoulder presentation*, where the liquor amnii has drained away, the shoulder is jammed down into the pelvis and the uterus is firmly retracted over the child. The danger in attempting version is that the uterus may be ruptured. The correct treatment is decapitation (p. 749). This may have to be performed even if the child is alive; as, in addition to the danger of rupturing the uterus, the prospect of delivering a living child, or one who will survive, is remote (foetal mortality, 50 to 60 per cent.).

The question of Cæsarean section may have to be considered. But its place is not after fruitless attempts at version have been made; it should be chosen as an alternative to internal version if a definite pelvic deformity exists, or if the child is unduly large and the pelvic formation is slightly below the normal.

The unfortunate terminations which frequently occur with this abnormality illustrate the value of preventive methods of treatment. Few of them need happen if the condition is recognised and corrected at the end of pregnancy or early in labour.

ARM PRESENTATION

As we have already seen, oblique presentations ultimately resolve themselves into presentations of the shoulder. Very frequently, therefore, an arm prolapses and can be easily felt in the vagina; later it may actually protrude from the vagina. The manner of distinguishing the hand from the foot and the elbow from the knee have been already described. It has also been pointed out how the position of the foetus *in utero* can be determined by noting the attitude of the prolapsed arm (p. 477).

There is nothing special in the treatment of arm presentations, but there is one useful device—viz., to attach to the prolapsed arm a loop of gauze—this procedure permits the arm being easily brought down, after version has been performed

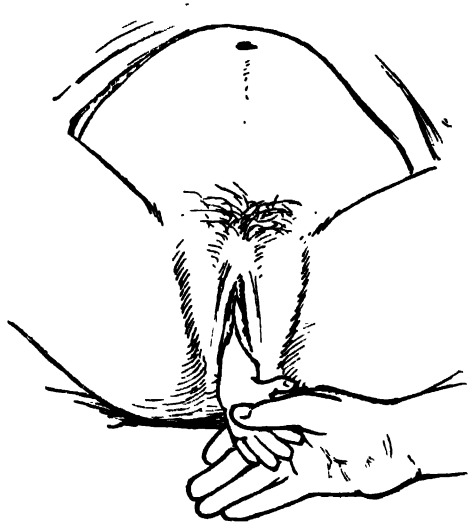


FIG. 186.—Prolapse of Right Arm.

and the breech has been delivered. It is not necessary to replace the arm before passing the hand into the uterus to grasp a leg.

COMPOUND PRESENTATION

This term is applied to a condition in which an extremity prolapses alongside the presenting part. We have already referred to prolapse of the arm in vertex presentation (p. 457). More complicated is the case in which a foot and arm present along with the head. This is a very rare occurrence, and is generally associated with a premature or macerated foetus.

The treatment is to push up the prolapsed limb or limbs and allow the head to enter the pelvic cavity; podalic version (p. 697) is seldom necessary, but should be employed if the limb or limbs cannot be replaced. After replacement of the limb or limbs it is generally advisable, if the os uteri is fully dilated, to apply forceps to the head and cautiously extract it, as otherwise the limbs may again prolapse.

When an arm and leg prolapse in a shoulder presentation version is facilitated, as the leg can be readily grasped and the breech brought down.

CHAPTER XXVII

FAULTS IN THE FŒTUS OR PASSENGER (*continued*)

General Enlargement—Local Enlargements—Monsters

GENERAL ENLARGEMENT OF FŒTUS

Abnormal Size of Fœtus.—It is found that the healthy woman, until the age of thirty to thirty-five, tends to have a slightly larger child with each succeeding pregnancy. It is peculiar to certain individuals to have very large children—ten or eleven pounds is a large child, but all maternity hospitals have records of children weighing twelve to fifteen pounds. The largest child of which a record can be found is that reported by Lawton Moss¹—it weighed twenty pounds two ounces at birth. Heredity and prolongation of pregnancy (p. 183) are the two most important causative factors.

Encountered in a primipara, difficulty may be experienced in delivering a large child, even when it presents in the most favourable vertex position. Naturally, the difficulties are greatly increased if, for example, the presentation is an occipito-posterior or a breech, or if the maternal canal is below the normal. Indeed, in such cases the operator may find it impossible to deliver the child by the ordinary methods of forceps or traction on the limbs. He is compelled, therefore, to choose between Cæsarean section and craniotomy. Undoubtedly the ideal treatment is Cæsarean section, provided the child is alive ; but in actual practice craniotomy may be the wiser course, for the child has generally suffered a good deal before the operator fully recognises the difficulties—indeed, he very often does not appreciate them until he is engaged in the delivery. In most instances, therefore, it is better to perform craniotomy, and, in a subsequent pregnancy to induce labour at the thirty-sixth week, or allow the pregnancy to continue to term and perform Cæsarean section—in practice it will generally be found that the simpler procedure of induction of labour gives excellent results.

The advocates of a routine radiographic examination for all primigravidaë naturally claim that the condition can be recognised before labour. We would recommend that, in all cases in which an unusually large child is suspected, a radiograph should be taken. If the radio-

¹ *Proc. Roy. Soc. Med.*, 1929, vol. xxii., p. 1435 (photograph).

graph shows an extremely large child and its cranial measurements are above the normal, Cæsarean section should be employed.

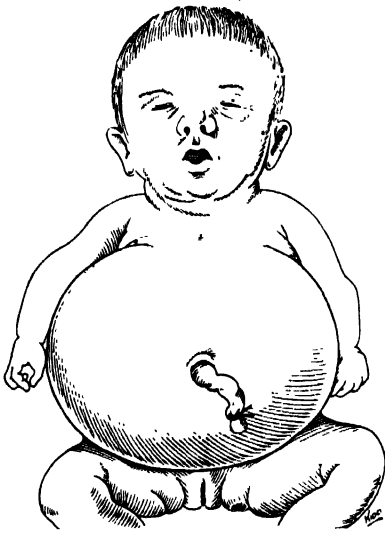


FIG. 187.-General Dropsy with Ascites.

General Fœtal Dropsy.—Reference is made elsewhere (p. 315) to the causation of general fœtal dropsy—for the moment we are concerned with the condition as a cause of dystocia.

The difficulties encountered in delivering a fœtus affected by dropsy are seldom extreme, although the ascites so often present may interfere with the delivery and necessitate puncturing the abdomen with a perforator or scissors. In most instances the head has been extracted or the legs brought through the vulvar orifice before the condition is recognised. Very often the head or limbs break off during extraction of the trunk. One need

have no hesitation in perforating the abdomen or dismembering limbs as the child's condition is hopeless.

LOCAL ENLARGEMENTS OF FŒTUS

These enlargements may be limited to :

1. *Head* : hydrocephalus ; encephalocele, meningocele.
2. *Neck* : congenital bronchocele ; other tumours.
3. *Shoulder* : large shoulder girdle ; tumours.
4. *Thorax* : hydrothorax ; tumours.
5. *Abdomen* : ascites ; distended bladder ; tumours of kidney, spleen, liver.
6. *Pelvis* : large pelvis ; tumours.

Radiographs of a number of these abnormalities are shown in Chapter LX.

Before considering these malformations individually, we would stress the fact that the actual operative procedures necessary are comparatively easy to perform. The danger consists in forcibly extracting the child by forceps or traction on the limbs without determining what really is the cause of the delay and difficulty in the labour. Many serious injuries have been inflicted on the mother, such as rupture of the uterus, from not appreciating this. Further, in practically every example of the complications to be discussed, the child's condition is hopeless, consequently its life demands no consideration.

Hydrocephalus.—In this condition the cerebral ventricles are distended with cerebro-spinal fluid. The quantity may reach as much as 10 to 15 pints (6 to 9 litres), and the circumference of the head may be as much as 30 inches (75 cm.). The trunk of the child is generally puny, the face small although well formed; but the vault of the cranium is enormously distended, the individual bones being separated by gaping sutures and fontanelles. Other abnormalities in the foetus are not infrequent, such as spina-bifida, talipes, etc.

Although by careful abdominal palpation it may be possible to feel the enlarged head, more especially where the child presents by the head, the majority of examples of hydrocephalus are not recognised until labour is well advanced. In recent years since radiography has come to be employed if this condition is suspected, exactness of

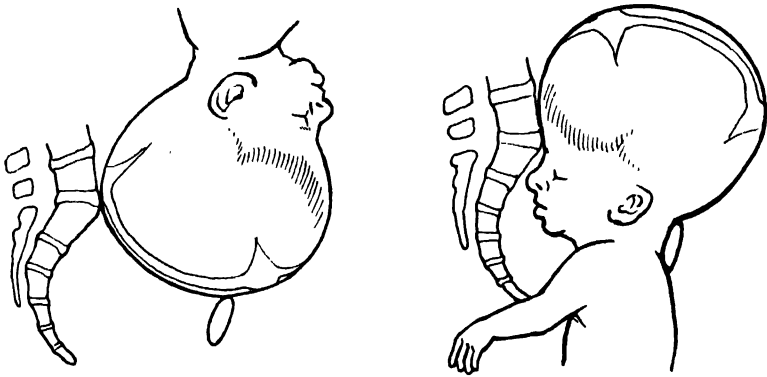


FIG. 188.—Hydrocephalus with Fore-coming and After-coming Head.

diagnosis is now possible. This permits the employment of induction of labour if the mother's condition calls for the termination of pregnancy, as is often the case, and the employment of craniotomy to diminish the size of the head.

The foetus may die shortly before or during labour, but not infrequently its vitality is fairly good and the foetal heart is heard. The position of greatest intensity of foetal heart-sounds may obviously be affected by a large hydrocephalus. The child presents either by the head or breech—oblique presentations are very uncommon. Breech presentations are relatively frequent, and occur in about 25 per cent. of cases.

We will consider this condition :—(a) when the head presents, and (b) when the breech presents.

FŒTUS PRESENTS BY HEAD.—Recognition of hydrocephalus (Fig. 188) when the head presents is not difficult, for the presenting part remains above the pelvic brim, and is felt by abdominal palpation as a large globular body more bulky and softer than the normal head.

There is always a certain degree of fixation of the head because the walls of the lower uterine segment are overstretched. There is, however, no descent of the head even after labour has been in progress for many hours and the membranes have ruptured.

Whenever the fingers can be passed through the cervix the elasticity of the presenting head and the fact that the sutures and fontanelles are widely separated should confirm one's suspicions that hydrocephalus exists. If the fœtus is dead or the head not tensely distended with fluid the mistake may be made of confusing the hydrocephalus with the bag of unruptured membranes, for in such cases a portion of the fœtal head projects somewhat into the pelvic cavity. But on more careful palpation the cranial bones can readily be felt.

The treatment of this condition is very simple. The head should be perforated, and this can be done with an ordinary pair of scissors should a perforator (p. 745) not be to hand. After perforation the head collapses and descends, or can be easily extracted with forceps. The serious injuries (rupture of uterus, etc.) which have resulted have generally occurred because the accoucheur has applied forceps to the head before perforating it, or has attempted version.

FŒTUS PRESENTS BY THE BREECH.—Here difficulty only occurs with the after-coming head, which, as shown in the illustration, is arrested at the pelvic brim. The inexperienced accoucheur may not recognise the condition by simple vaginal examination, for the base of the skull is more or less normal; it is only the vault of the head which is distended. In many cases palpation of the abdomen reveals an undue distension of the lower part of the uterus; but unless one is on the lookout for hydrocephalus it is not always easy to recognise it. *In practice the most important feature, and the one which should arouse immediate suspicion that hydrocephalus exists, is the fact that there is any difficulty whatsoever in delivering the child's head, for the trunk of the child is invariably puny, and other malformations, such as spina-bifida, talipes, etc., are not infrequently present.*

The great danger is attempting to deliver by forcible traction on the trunk and suprapubic pressure from above—the ordinary means employed to deliver the after-coming head. If the accoucheur makes forcible attempts at delivery there is every probability that rupture of the uterus will result because of the thinned-out condition of the lower segment (p. 600).

Treatment here again is simple. The head should be perforated behind the ear (p. 748). This can be done with an ordinary pair of scissors should the operator not have a perforator to hand. Immediately the skull is perforated the fluid in the ventricles escapes freely, the head collapses and is easily delivered. An alternative treatment has been suggested—viz., the withdrawal of the fluid by inserting a catheter into the spinal canal. This more complicated procedure is of no great practical value and is seldom employed.

The only further point of interest is : Can any children with this deformity be saved ? Speaking generally, none of them can be saved unless the hydrocephalus is so slight that there is practically no difficulty in delivering the head.

Meningocele and Encephalocele.—These cystic growths (Fig. 189), consisting of the meninges with or without brain tissue, are usually found in the vicinity of the posterior fontanelle. They are often difficult to recognise, because being “tucked away” behind the occiput they are inaccessible to the examining fingers in both cranial and breech presentations ; this is well illustrated in the accompanying figure. When the head presents they tend to produce a brow

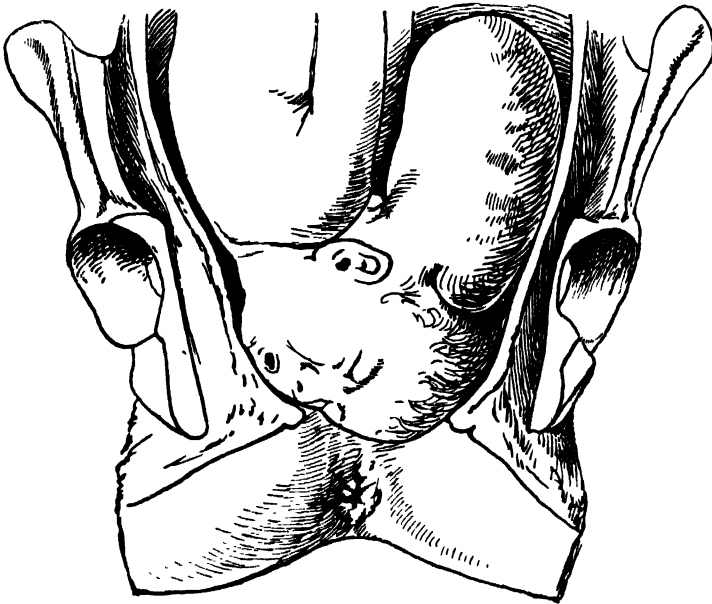


FIG. 189.—Encephalocele.

presentation, while if the breech presents they prevent descent of the after-coming head.

If one reads the clinical history of such cases it will be found that the sacs have often ruptured during forcible extraction of the child, and that in many instances the mother has been seriously injured. This need not occur. The condition should be suspected in a cranial presentation if the head is small and yet there is difficulty in extracting it ; and in a breech presentation if there is difficulty in extracting the after-coming head of an obviously small child.

The treatment is to perforate the sac with scissors or some pointed instrument. This allows the meningocele to collapse, and delivery is easy. Some children with this condition may be saved (*vide* Surgical Textbooks), but only if the meningocele is small and the stalk narrow.

Tumours of the Neck of the Child.—We show in the accompanying illustration (Fig. 190) the commonest tumour of the neck—namely, congenital bronchocele. It is very rarely encountered in this country, but is relatively common in certain parts of the Continent—for example, in the valley of the Rhine and in Switzerland.

The difficulties associated with congenital bronchocele are due not so much to the size of the tumour, for it is seldom extremely large, but to the fact that it produces an extension of the head and brings about a face or brow presentation. In breech presentation the extraction of the after-coming head may be rendered difficult because the tumour interferes with flexion of the head.



FIG. 190.—Congenital Bronchocele.

The diagnosis of the condition is simple, for the tumour can readily be felt just below the chin.

Should the accoucheur find it impossible to deliver the child easily the tumour must be broken up and the head perforated.

Large Shoulder Girdle.—With this condition there may be considerable difficulty in extracting the child, especially if the pelvis is in the slightest degree below the normal. It is generally associated with a large child; but it is encountered not

infrequently in the *anencephalic* monster in which the cranial vault and cerebral hemispheres are absent (*vide* Radiograph, Chapter LX).

Where the head presents the child is liable to be lost or seriously injured, because there has generally been considerable difficulty in delivering the head owing to its size. Then the brachial plexus may be lacerated from dragging on the head (p. 616). Further, in bringing down the arms, they may be fractured. In some cases it may be necessary to use a blunt hook (p. 471). If this instrument is employed great care must be exercised in placing it in position, as the humerus may be fractured or the superior epiphysis separated. Generally it is better to insert the hook round but not into the axilla, and to make traction direct on the shoulder. To bring down an arm with the blunt hook is very difficult unless, under the guidance of a hand in the vagina, the hook can be passed to the elbow of the child. Where it is impossible to deliver the shoulder or bring down an arm there is nothing left to the accoucheur but to divide the clavicles (Cleidotomy, p. 751).

Where the presentation is a breech, the delivery of the arms and especially of the after-coming head may be no easy matter (*vide* pp. 470-474).

Tumours of the Shoulder.—This complication is a great rarity.

It favours a shoulder presentation. As the tumour is almost invariably a sarcoma the child need not be considered, and consequently the delivery should be terminated in the manner safest to the mother. Generally it will be found of advantage to break up the tumour by a perforator or long scissors. This should be followed by decapitation if, as in most instances, the shoulder is the presenting part.

Distension and Tumours of the Thorax.—Complications of this nature are very great rarities. Occasionally, however, distension of the pleura, with fluid, tumours of the pleura, lungs or thymus gland have led to extreme distension of the thorax.

The correct procedure is to perforate the chest. If the distension is caused by fluid, evacuation of it results in the thorax collapsing. If the condition is a tumour it may be necessary to break up the intrathoracic growth before the child can be extracted.

Distension and Tumours of the Abdomen.—This complication is much more common than the two referred to previously. The foetal conditions which give rise to it are ascites, distension of bladder with atresia of urethra, hydronephrosis, and tumours of abdominal viscera. The three first mentioned are the commonest causes. There is an excellent radiograph in Chapter LX showing foetal ascites. The conditions are so serious and hopeless that the child's life need not be considered. The danger consists in overlooking the complication and forcibly extracting the child and doing injury to the mother.

Head Presenting.—Delay occurs after the head escapes. The complication should always be suspected where there is difficulty in extracting the trunk, and especially if the child's head and thorax appear puny. The obstruction is easily recognised by passing the hand up over the child's thorax, when the distended abdomen can be felt.

Breech Presenting.—Here the difficulty occurs at an earlier stage of the delivery, for if the abdomen of the child is extremely distended the breech may not descend into the pelvis (p. 468). The accoucheur should suspect hydrocephalus if the breech does not descend well, and especially if it appears to be small. He may have difficulty in feeling the abdominal distension until he brings down a foot or both feet; but as this is the usual procedure in cases of arrestment of the breech (p. 468) he should recognise the cause of the obstruction when he introduces his hand into the uterus.

The treatment consists in opening the abdomen with a perforator or scissors. If the condition is ascites the abdomen immediately collapses and completion of the delivery is simple. The same applies to distension of the foetal bladder. If, however, an intra-abdominal tumour is the cause, such as a hydronephrosis, retroperitoneal sarcoma, etc., it may be necessary to make a larger opening into the abdomen, perform evisceration (p. 750) and remove the tumour.

Tumours of Sacrum.—This is a relatively rare complication. It is well illustrated in the accompanying figure (Fig. 191). Generally the tumour is a sarcoma or teratoma. Where the head presents there is seldom much difficulty in extracting the breech. Where, however, the child presents by the breech there may be difficulty in determining what is presenting. Indeed, until the hand has been passed into the uterus a correct diagnosis is often impossible. The tumour should be broken up by a perforator or scissors, the trunk delivered by traction on the limbs, and the after-coming head perforated.

Single monsters, and the malformations of the foetus just described, are complications which need not seriously endanger the mother

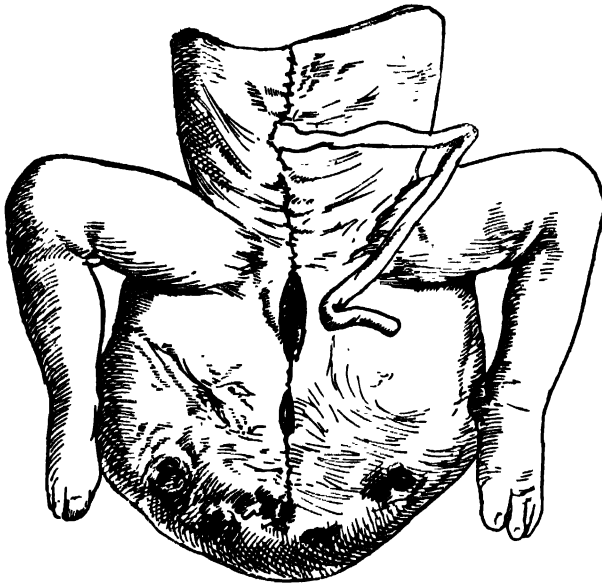


FIG. 191.—Tumour of Sacrum (Sarcoma).

provided they are recognised early and suitably treated. On the other hand, double monsters, because of their size, may be extremely difficult to deliver.

DOUBLE MONSTERS

Double monsters are examples of uniovular twins in which the common blastoderm has not completely divided into two (p. 493). The degree of imperfect division varies; there may be only a slight band of union between the two or there may be very intimate fusion.

We divide double monsters into two groups: (1) Asymmetrical disomata where the foetuses are united by dissimilar parts. (2) Symmetrical disomata where the two are united by corresponding parts (head to head, etc.)---they are generally of equal size.

Asymmetrical Disomata.—These are often of very unequal sizes, the smaller appearing sometimes as a parasite of the other (Fig. 192).

Symmetrical Disomata.—The three main varieties are (Fig. 193): (a) *Thoracopagus*, where the two foetuses have their trunks united, but have distinct heads and limbs; (b) *Dicephalus*, where the foetuses have two heads, four upper limbs, but usually only two lower limbs; and

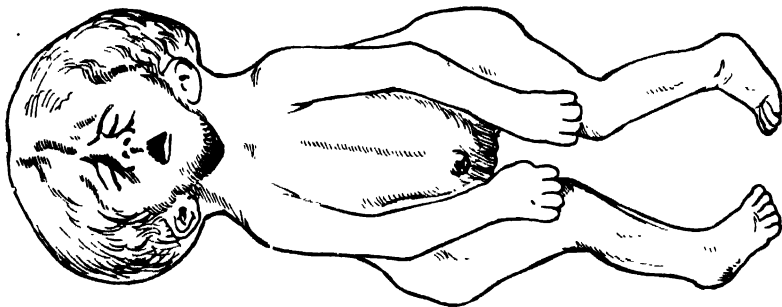


(Photograph by Dr Biddle, Ipswich.

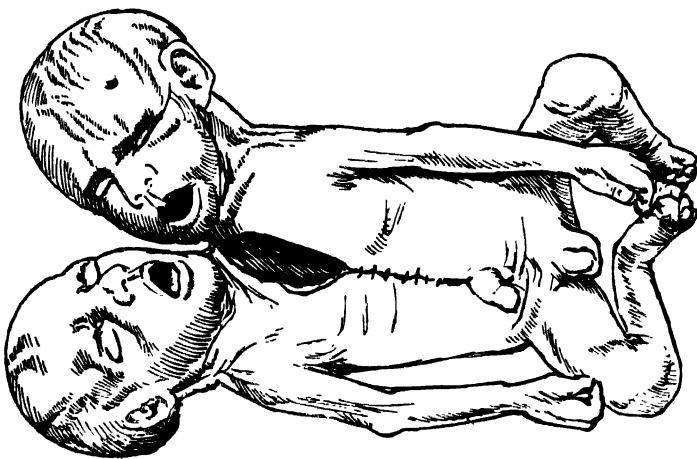
FIG. 192.—Double Monsters (Asymmetrical Disomata).

(c) *Syncephalus*, where the two heads are fused; there is often only one set of upper limbs, but always four lower limbs.

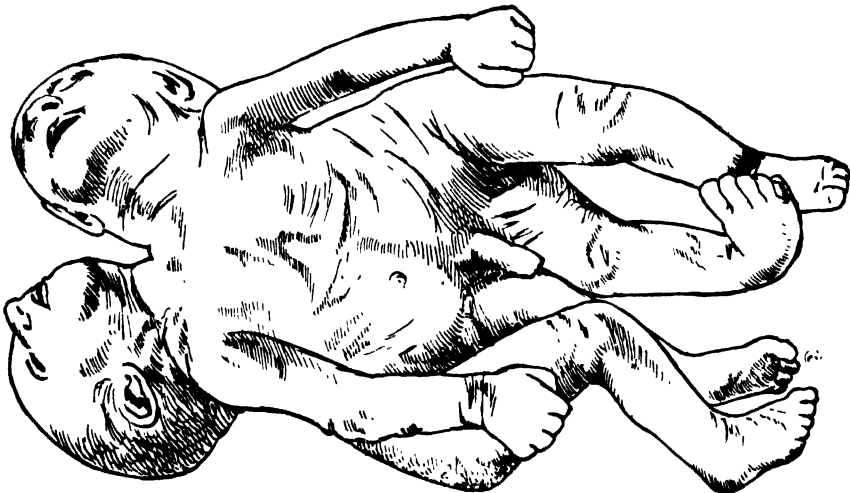
DIAGNOSIS.—It is obvious that with these varieties of double monster great difficulty may be experienced, firstly in diagnosing the condition and secondly in effecting the delivery; this applies especially to cases in which they present by the head. In recent years it has been possible on occasions, by radiography, to recognise these monstrosities in pregnancy; but not always. In the case of the thoracopagus, if the union between the two is slight the radiograph may present the picture of a simple plural pregnancy.



Syncephalus



Dicephalus



Thoracopagus

FIG. 193.—Double Monsters (Symmetrical Disomata).

TREATMENT.—The variety which gives least trouble is the *syncephalus*. If it presents by the head, the head should be perforated and the rest of the child extracted. If it presents by the breech and the limbs are brought down, the complication, as in hydrocephalus, should be suspected if the head is found to be unusually large. Craniotomy should be performed on after-coming head (p. 748).

The varieties which cause greatest trouble are the *thoracopagus* and the *dicephalus*, especially if the heads present. Generally speaking, it is a good rule to perform version and bring down the limbs. The mass can then be broken up in detail and the after-coming heads perforated or removed. Should the labour have advanced beyond the stage when version can be safely performed, the foetuses must be broken up and removed. This may be a very tedious and most difficult procedure.

Cæsarean section should be seriously considered if the condition is recognised by radiography before labour, or diagnosed by this or by other means early in labour. With this method of delivery the risks of infection and injury to the parturient canal, associated with a difficult delivery by the vagina, are avoided.

CHAPTER XXVIII

PLURAL PREGNANCY

THE term plural is applied to a pregnancy if more than one foetus is present. The largest number recorded is seven. The commonest form is twins, and this occurs once in about 80 to 90 births. Triplets occur once in about 8000 and quadruplets once in about 400,000 births. There have been reported 30 cases of quintuplets and 6 of sextuplets. Multiple pregnancy appears to be relatively more common in certain countries, as, for example, Russia and Ireland. It is commoner amongst coloured than amongst white races.

Ætiology.—Heredity is the all-important factor. The tendency transmitted through the female line is easily explained in the case of binovular twins—here there is an inherited tendency to double or even multiple ovulation. In the case of uniovular twins there may also exist an inherited tendency to produce ova with the inherent properties necessary for this particular variety of twinning. More difficult to explain is a hereditary influence through the male, although there are many instances which give colour to this possibility—more, probably, than can be explained by accidental coincidence. After all, no matter how abundant and potent the sperm of a particular male may be it can only fertilise the ova supplied by the female; although conceivably in the case of uniovular twins in which the two foetuses are derived from division of a single blastocyst the sperm of particular males may influence such a division.

Varieties.—Twin pregnancies are of two varieties, known as “binovular twins” and “uniovular twins.” The binovular variety is about five times as frequent as the uniovular.

The combined weight of the twins varies greatly; if the pregnancy continue to term, or nearly to term, they together weigh from ten to twelve pounds on an average.

Binovular Twins.—In this variety the embryos develop from two distinct ova shed from (a) two follicles in one ovary or from one follicle in each ovary, or (b) one follicle which contains two ova. It is not uncommon to find two ova in one discus proligerus if sections of ovary are examined microscopically. The two ova are generally fertilised at or about the same time. Occasionally, however, the fertilisation may occur at different dates, consequently the two foetuses may be of different ages. Thus we may have the condition of (a) *superfecundation*, where the fertilisation of the two ova has occurred

at different times of the same intermenstrual period (a condition very difficult to determine, for the difference in age is so slight), or (b) *superfœtation*—viz., the fertilisation of two ova shed at different intermenstrual periods. In this latter condition the two ova may be of very different ages. But there is a limit to the difference in age, for a second fertilisation can only occur so long as the uterine cavity has not become completely obliterated by fusion of the deciduæ capsularis and vera, which takes place about the end of the third month of pregnancy. Superfœtation is rare and difficult to determine—two fœtuses which, so far as appearances and weight go, are of different ages may really be of the same age, only one has not developed so satisfactorily as the other. This generally results from disturbance in the placental circulation of the affected fœtus. An X-ray examination of the centres of ossification may clear up the uncertainty.

In binovular twin pregnancy there are two distinct chorions, two

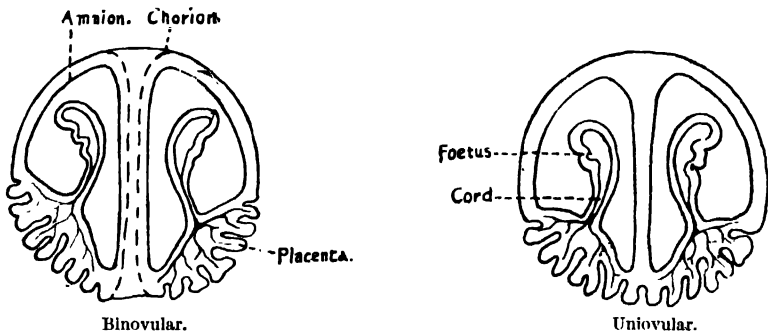


FIG. 194.—Two Varieties of Plural Pregnancy.

distinct amnions, and no communication whatever between the circulations in the two placenta (Fig. 194). The placenta, however, may be placed close together and apparently fused into one mass; in other cases they are separated to a varying extent by the foetal membranes.

The sexes may or may not be the same. The children are generally stronger, although one may occasionally suffer from unfavourable position, interference with the development of its placenta, faulty insertion of its umbilical cord, or anything that is prejudicial to its growth and development.

If there is extreme interference with the growth and development of one ovum it may die and be expelled; more commonly it is retained until term and expelled with the living one. Sometimes such a fœtus retained *in utero* becomes flattened out, and compressed between the uterine wall and the membranes of the healthy fœtus. This condition (*fœtus papyraceus* or *fœtus compressus*) is not peculiar to binovular twins.

Uniovular Twins.—Here there occurs the fertilisation of a single ovum in which the blastocyst divides. Apart from inherent forces

which determine this occurrence, it is maintained that environmental influences play a part. Imperfect division of this type results as we have seen in a double monster. The arrangement of the placenta and membranes differs in this variety. There is one chorion, two amnions and one large placenta. There is always a communication between the two placental circulations. It may be very slight in some instances. But in others it is very complete; in which case there may be serious interference with the growth and development of one foetus. In an extreme form there is a damming back of the blood-stream in the weaker foetus, so that its circulation is so seriously interfered with that it dies. With uniovular twins, and only in this variety, we encounter occasionally a very interesting monster—viz. the *foetus acardiacus* (heart and upper part of trunk an irregular mass of tissue, lower limbs distinct but head absent or head present and limbs absent). Probably in this monster an inherent developmental error is more responsible for the malformation than intercommunication between the circulations of the two foetuses.

The communication between the two circulations explains also the frequent occurrence of hydramnios in uniovular twins (p. 306).

We have mentioned that there are always two distinct amnionic sacs, but occasionally the partition disappears, and in the later months the two foetuses may occupy one amnionic cavity. In such circumstances the two cords may become entangled or knotted (p. 504).

The foetuses in this variety are always of the same sex, very closely resemble each other in appearance, are generally smaller in size, and are not quite so robust as binovular twins. Malformations are relatively more frequent.

Course of Pregnancy.—In about 70 per cent. of cases premature labour occurs. All the complications of pregnancy—*e.g.* toxæmia, placenta prævia, hydramnios, etc.—are relatively more frequent. The general discomforts associated with pregnancy are greater because of the extreme distension of the uterus and the mechanical pressure it exerts on the neighbouring organs.

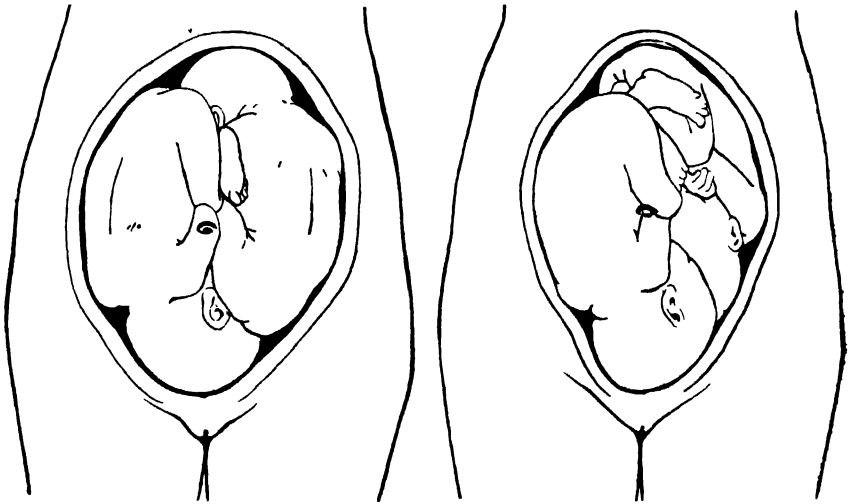
Diagnosis.—The diagnosis of twins by abdominal *palpation* is not always easy. To trust to such conditions as overdistension of the uterus or the apparent multiplicity of limbs will result undoubtedly in mistakes being made. To determine a plural pregnancy by palpation, one must feel either two breeches or two heads. The cases which present the greatest difficulty are those in which the foetuses are placed one in front of the other, as shown in Fig. 195 (B), and the cases in which palpation is relatively easy are where the foetuses are placed more or less side by side (Fig. 195 (A)). In the latter, especially if one presents by the head and the other by the breech, the two heads can generally be easily defined.

Confusion may occasionally arise if fibromyomata are present in

the uterine wall, or an ovarian cyst of some size produces an irregular abdominal distension.

As regards *auscultation*, a diagnosis of plural pregnancy can only be made if the heart-rates at two distinct points differ in frequency. In theory this should be a useful sign, but, as a matter of fact, there is rarely a difference of more than seven or eight beats per minute, which is difficult to appreciate.

Vaginal examination is seldom of much assistance prior to the onset of labour. Very occasionally two intact bags of membranes can be felt through the cervix if labour has started and the cervix is sufficiently dilated. Later, when two fingers can be passed through the cervix, a



(A) Fetuses side by side.

(B) Fetuses—one anterior, other posterior.

FIG. 195.—Plural Pregnancy.

prolapse of a foot at the side of the presenting head, a pulseless cord, while auscultation reveals the presence of a living child, the presence of two heads or two breeches side by side may justify a positive diagnosis. As a matter of fact, in practice many plural pregnancies are only recognised after the first child is born.

In many instances the only means of arriving at an exact diagnosis of a plural pregnancy is by radiography.

The student may very naturally ask the question: Is it of great consequence that plural pregnancy should be diagnosed? Apart from the general principle that the diagnosis of all conditions should be as exact as possible, the recognition of a plural pregnancy is not of much consequence. One circumstance under which we have found it of value is where, with slight deformity of pelvis, the question of induction of labour had to be considered. With a plural pregnancy it is unnecessary to induce labour, as the fetuses are small. An exact diagnosis may be of value also in cases of hydramnios where plural

pregnancy is suspected. In such cases the radiograph may show malformations in one or both foetuses and this knowledge may influence treatment.

The following table indicates the disposition of the two foetuses (Leonard's table, based on 1840 cases):—

<i>First</i> Head	<i>Second</i> Head	38·5 per cent.
Head	Breech	21·1 „
Breech	Head	14·3 „
Breech	Breech	10·7 „
Head	Transverse	8·3 „
Transverse	Head	0·8 „
Breech	Transverse	4·2 „
Transverse	Breech	0·7 „
Transverse	Transverse	0·9 „

Labour and its Management.—The course of the labour is little disturbed, for, although uterine contractions may be weaker from overdistension of the uterus this is seldom of much consequence and disappears after the bag of membranes of the first child ruptures. As labour often comes on prematurely and the foetuses are small the parturition may not be prolonged. After determining the presentation of the *first child* labour should be allowed to run a natural course. It is advisable to rupture the membranes whenever the os is well dilated should this not occur spontaneously.

After the first child is born the cord should be tied with double ligatures, as failure to ligate the placental end might lead to hæmorrhage and death of the second child should there be a communication between the placental circulations.

Following the birth of the first child the uterus rests, and this rest may continue for some considerable time; indeed, if left to Nature, hours may elapse. The average time between the births is variable, but about thirty minutes to an hour is the ordinary interval.

As the *second child* may readily assume an unfavourable position after the first is born, an abdominal and vaginal examination should be made, any abnormal presentation corrected and the membranes ruptured.

A number of operators advocate internal version for the second child as a routine. We have no great objection to this procedure as extraction is generally easy; but in most instances it is unnecessary. The second child is generally driven through the parturient canal with one or two contractions if it presents by head or breech.

In practically all cases the placenta follows the birth of the second child; but occasionally it happens that the placenta of the first has followed its expulsion. It is in such cases that the presence of a second child has been overlooked occasionally. Indeed, cases have occurred in which uterine contractions have quietened down and the second child has been retained for days, even weeks.

After the birth of both placentæ and membranes a full dose (1 c.c.) of pituitrin should be given to prevent postpartum bleeding. Some writers recommend the administration of 0.5 c.c. pituitrin after the birth of the first child ; but we prefer to delay giving it until the uterus is completely empty, unless conditions indicate its employment.

SPECIAL DIFFICULTIES AND COMPLICATIONS.—One of the minor difficulties encountered is where the first child presents by the breech. With such an occurrence (as seen from the table, it occurs in 14 per cent. of cases) there may be a little trouble in delivering the after-coming head, because of the difficulty in applying suprapubic pressure. Fortunately, however, as the child is generally small, extraction is

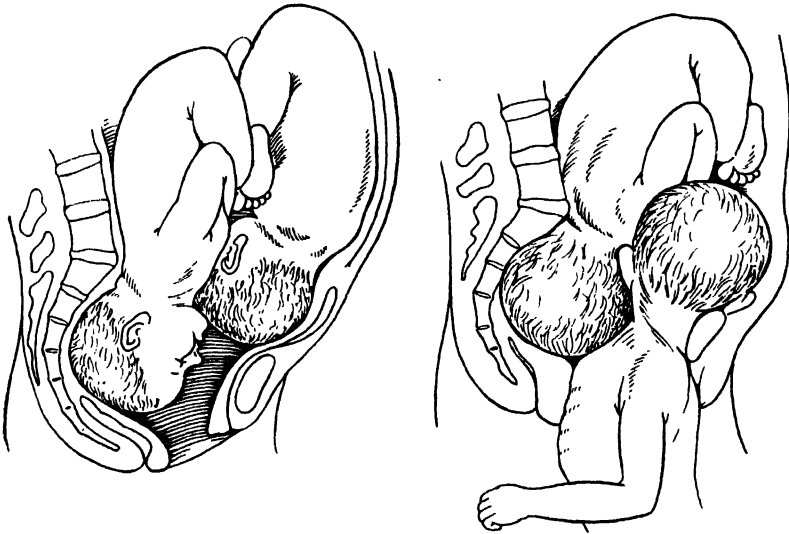


FIG. 196.—Two varieties of "Locked Twins."

comparatively easy. If there is any difficulty forceps may be employed when the head is in the pelvic cavity (p. 705).

The most troublesome complication is "locking" of the twins. This, although described in all textbooks, is a very great rarity. The accompanying illustrations show two varieties of locking (Fig. 196)—the one where the two heads become impacted in the pelvis, and the other where the after-coming head of the first child becomes locked with the fore-coming head of the second. The first one is never of any serious consequence, for the presenting head of the second child can be readily pushed up. But the second variety may necessitate the decapitation of the first child provided the second child's head cannot be pushed out of the pelvis. Other examples of locking have been described—*e.g.* where all four legs have prolapsed—but it is unnecessary to discuss such extreme rarities.

We have mentioned already the danger of postpartum hæmorrhage.

This and shock are the commonest complications encountered. To combat these possible conditions it is advisable in all cases to have ready to hand a normal saline solution in case it may be necessary to administer an intrauterine douche and intravenous or rectal transfusion.

Prognosis.—Maternal mortality is higher with plural than with single pregnancy because of the greater incidence of ill-health, toxæmia, anæmia during pregnancy, and the greater liability to postpartum hæmorrhage and shock following labour. For the children the prognosis is very definitely worse—prematurity, malnutrition, deficiency of vitamin D and iron account for the relatively high death-rate in the first year. The mother therefore requires very particular supervision during pregnancy, labour and the puerperium. The children also require very careful tending as regards warmth, diet, etc.

CHAPTER XXIX

COMPLICATIONS CONNECTED WITH THE UMBILICAL CORD AND MEMBRANES

A. UMBILICAL CORD OR FUNIS

Presentation and Prolapse of the Cord or Funis.—We have here two distinct conditions, *presentation* and *prolapse* of the funis, the former a falling down of the cord in front of the presenting part before rupture of the membranes, and the latter a similar occurrence after rupture. Prolapse in most cases is preceded by presentation, but in not a few it is only with rupture of the membranes and the escape of the liquor amnii that the former occurs. The frequency of this complication is 1 in 300 to 400 cases. If, however, the maternal pelvis is normal and the foetal head occupies the first or second vertex position, prolapse of cord occurs very seldom (approximately 1 in 1600 cases). For this reason many obstetric specialists dispense with a vaginal examination early in labour if they are satisfied that maternal pelvis and position of foetus are normal (p. 403). On the other hand vaginal examination early in labour is advisable, if there is any obvious or suspected abnormality, for the purpose of ensuring that a presenting or prolapsed cord is not overlooked.

ÆTIOLOGY.—The conditions which favour the occurrence of prolapse of the cord are malpresentations and anything which interferes with the engagement of the presenting part. It is consequently not uncommonly encountered in transverse, breech, face and brow presentations and when the pelvic brim is deformed (flat pelvis). Then again, such conditions as low implantation of the placenta, marginal attachment of the cord, undue length of cord, hydramnios, sudden rupture of the membranes (especially if the parturient is in the erect posture) are all favouring conditions.

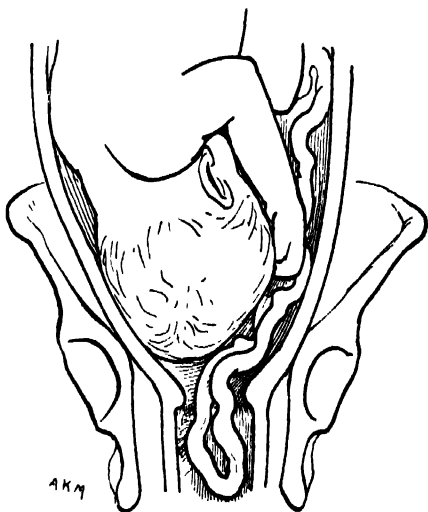


FIG. 197.—Prolapse of Cord.

The position of the prolapsed funis depends chiefly upon the position of the fœtus, for the cord falls down generally on the side to which the abdomen of the fœtus is directed (Fig. 197).

The extent to which the cord prolapses varies. Sometimes only a small loop, but at other times many inches fall down. But no matter whether the prolapsed loop is long or short, the child's life is endangered if the condition is left uncorrected. Possibly a short loop is more easily replaced and kept up; it is more readily overlooked, however.

DIFFERENTIAL DIAGNOSIS.—Few conditions simulate a prolapsed cord—none if pulsations in it can be felt. Sometimes, when there is great difficulty in reaching the presenting part, the tips of the child's toes or fingers resemble the cord, for they move away from the examining finger just as does the cord. In many textbooks it is stated that the prolapsed intestines of the mother or child may simulate a prolapsed cord; but they are extremely rarely encountered. Prolapse of the mother's intestines can only occur with intraperitoneal rupture of the uterus, and prolapse of the fœtal intestines in exomphalos.

But there is one condition—viz., a flattened, pedunculated, cervical polypus (submucous myoma)—which exactly resembles a short loop of cord and may be difficult to distinguish from the latter if the patient is very stout and the presenting part is still high in the pelvis.

Having decided that the body felt is the cord, the next point to determine is whether or not pulsations are present. To do this the cord should be pressed against the presenting part or cervical wall, or, better, between the two examining fingers. Possibilities of error are pulsations in the mother's vessels and in the examining fingers of the accoucheur. With a feebly pulsating cord high in the canal it is difficult to exclude these fallacies. The child, however, is not always dead when no pulsation can be felt, during a uterine contraction if the circulation in the cord is completely obstructed, pulsation is entirely absent although it returns as each contraction ceases. Gradually the pulsations become slower, irregular, and take longer to return, and finally cease altogether. If, therefore, a prolapsed cord is diagnosed, it is necessary to note the presence or absence of pulsations, both during and in the intervals between the "pains."

PROGNOSIS.—In prolapse of the cord the chief danger is to the child. The risks to the mother are proportionate to the operative interference undertaken in the interests of the child.

Speaking generally, presentation of the cord—that is, a falling down of the cord when the membranes are intact—is not of *immediate* consequence. It is only after rupture of the membranes that the circulation in the cord becomes interfered with. Then the extent of prolapse, position of cord in the pelvis, degree of dilatation of the cervix and the pelvic formation influence prognosis very decidedly.

The fœtal mortality in cases treated by the ordinary methods to be described is very high (60 to 70 per cent.). For this reason Cæsarean

section has come to be employed somewhat freely in maternity hospitals. If cases subjected to Cæsarean section are most carefully selected the results are very good indeed.

TREATMENT.—The treatment of this complication depends upon several circumstances, but mainly upon the condition of the membranes, the degree of dilatation of the cervix, the condition of the child, and any additional abnormality.

Membranes unruptured.—Every endeavour must be made to preserve the membranes intact. With this object the patient is kept in bed; no attempt is made to replace the cord, except by employing postural treatment—*e.g.* raising the foot of the bed or placing the patient in the genu-pectoral, Sims', or Trendelenburg position. They have the effect of raising the pelvis and bringing the cervix to a higher level than the fundus; this allows gravity to act on the prolapsed cord. The treatment is sound in theory, but unfortunately not always successful in practice.

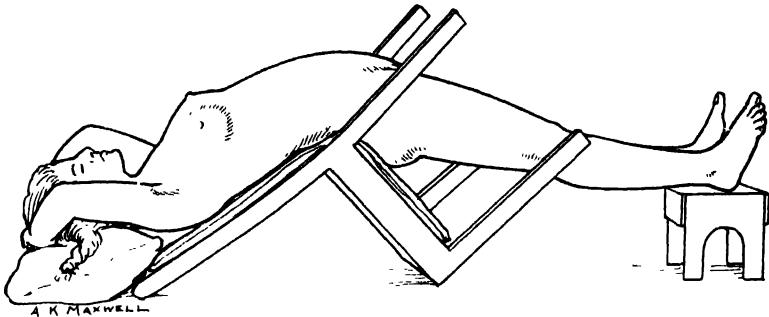


FIG. 198. — Improvised Trendelenburg Position.

The "knee-elbow" position has been already referred to and figured in connection with retroflexion of the gravid uterus (p. 289). The Trendelenburg position (p. 1060) necessitates a suitable operating table. It has been suggested that for domestic practice a modified Trendelenburg position is secured by utilising a chair (Fig. 198), but this device is of little value. These positions are very uncomfortable for the patient, and offer no advantage over Sims' position (p. 447), especially if a firm pillow is placed below the trochanter on which the patient is resting.

In this type of case Cæsarean section gives excellent results.

Membranes ruptured.—With the reservations made regarding additional abnormalities treatment depends upon the condition of the child and the degree of dilatation of the cervix. If pulsations in the cord have ceased, and the child is dead, the labour should be allowed to pursue its ordinary course and the delivery hastened with forceps, etc., only if this is to the advantage of the mother. Further, if deemed advisable, the fore-coming head, or the after-coming head (if the presentation is a breech), may be perforated in order to lessen the chances of any injury to the perineum.

One must, however, make certain that the pulsations have ceased, and so the loop of prolapsed cord must be carefully felt, not only during the "pains" but also in the intervals between them. As already pointed out, the child dies slowly; for a considerable time before its death pulsations may be quite good during the intervals between the pains, although they are entirely absent while the pains are in progress.

Let us now consider treatment of prolapse of the cord from the point of view of degree of dilatation of the cervix. We shall take three stages: (a) Os slightly dilated; (b) os half dilated; (c) os fully dilated.

(a) *Os slightly dilated*.—The outlook in cases of this nature is bad. The only hope of saving the child is to replace the cord with a repositor.

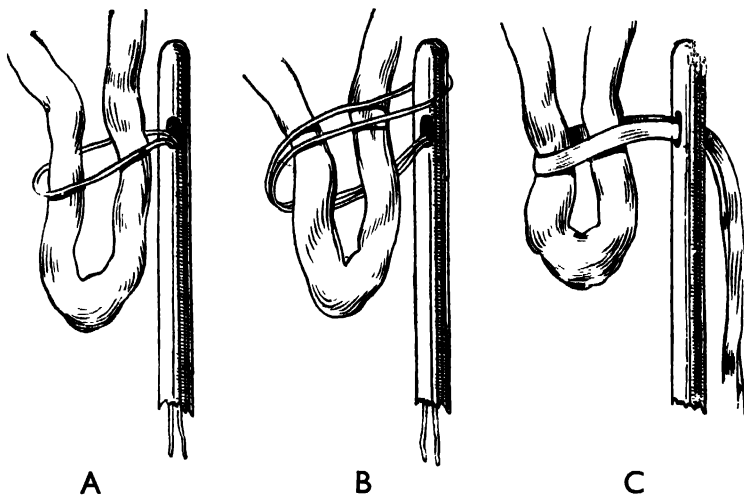


FIG. 199.—Simple Devices for replacing the Cord by means of a Gum-elastic Catheter.

A and B. Silk thread passed up through lumen and eye. C. Second opening made in catheter and fine tape employed.

Different instruments may be employed. Several centuries ago a sponge was recommended. We do not employ sponges because they are very difficult to sterilise; but a thick roll of sterilised gauze is a good substitute. One end of the gauze should be entangled in the cord and the gauze and cord pushed up into the uterus---this is the simplest and best repositor.

A gum-elastic catheter is very commonly recommended. There are various ways of utilising the catheter (Fig. 199). A silk thread may be pushed up the lumen and brought out through the eye of the catheter; or a piece of tape may be brought through the end. The loop of thread or tape is placed round the prolapsed loop of cord and tightened slightly. Then the catheter is carried up as high as possible into the uterus and silk thread or tape loosened. Special repositors have been devised, but none have proved of much value. All these devices are simple in theory but difficult to employ in practice.

Cæsarean section may be employed occasionally in cases of *prolapse* of the cord with the cervix only slightly dilated, provided pulsations in cord are strong. As the foetal mortality under such circumstances (membranes ruptured) must be high, Cæsarean section should be employed with great discretion.

(b) *Os half dilated*.—Here with a good pulsating cord the best procedure is to anæsthetise the patient, pass the hand into the vaginal canal, carry up the cord, and loop it over a limb. In our opinion this is preferable to introducing a Champetier de Ribes bag (p. 742). In this type of case the foetal mortality should not exceed 30 per cent.

(c) *Os fully dilated*.—If the cervix is fully dilated the child should be extracted with forceps, or, should the presentation be a breech, by traction on the trunk. In this type of case with a good pulsating cord the foetal mortality should not exceed 10 to 15 per cent.

Abnormal Attachment.—Normally the cord is attached about the centre of the placenta. Very frequently, however, it is placed more to the side. This is specially marked in the condition known as *battledore placenta*, where the cord is attached to the edge of the placenta (p. 311). Another abnormal insertion, not very infrequent, is the so-called *velamentous insertion*, where the vessels are spread out on the membranes before they reach the placenta (p. 311). If the placenta is situated relatively low the vessels may spread out low on the membranes. This condition termed

vasa prævia may be of serious consequence to the child, should a vessel be torn when the membranes rupture, as the child may bleed to death. Fortunately, it is a very rare occurrence.

Undue Length of the Cord.—The normal length of the cord is from 18 to 20 inches (45-50 cm.), but cords measuring 30 or more inches (75 cm.) are frequently encountered.

Undue length of the cord naturally predisposes to prolapse. If convolutions of cord become wound round the trunk or neck of the foetus, the growth and development of the foetus may be interfered with. Indeed, it has occasionally happened that the child has been strangled, or a limb permanently injured. It is questionable if intrauterine amputation has ever resulted from this cause. Not infrequently also, with a very long cord, knots are formed; these are referred to later (p. 505).

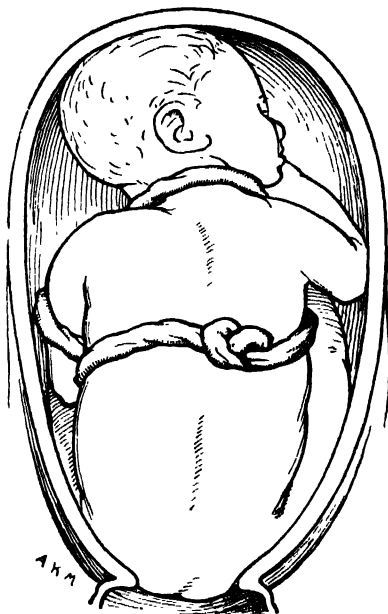


FIG. 200.—Knot in Cord wound round the Child.

Undue Shortness of the Cord.—In some malformations of the foetus, more particularly exomphalos, the cord may measure only 2 to 3 inches (5·7·5 cm.), but with a normal foetus it rarely falls below 7 to 8 inches (17·5-20 cm.).

A distinction is sometimes made between *absolute* and *relative* shortness of the cord. By absolute shortness is meant the condition just referred to, whereas relative shortness is where the cord becomes wound round some part of the child, most commonly the neck or trunk. This latter variety is seldom of any consequence.

Shortness of the cord may interfere with the descent of the child, both in head and breech presentation. Occasionally cases are encountered, for example, where there is difficulty in extracting the trunk after the head and shoulders are born, or in delivering the upper part

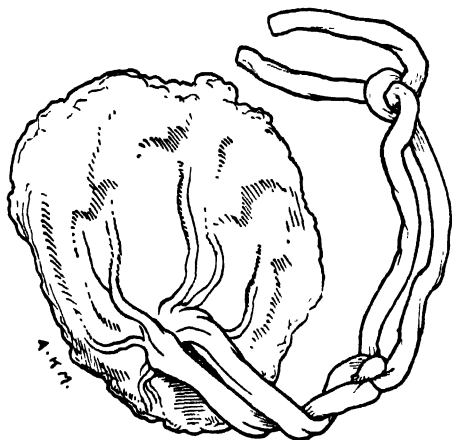


FIG. 201.—Knot in Cords in Uniovular Twin Pregnancy.

of the trunk and head where the foetus presents by the breech. Indeed, in a few instances it is necessary to divide the cord before the child can be extracted. If possible, the foetal end of the cord should first be clamped with pressure forceps. But sometimes this is impossible, and so the cord has to be divided, the child quickly extracted, and the cord ligated immediately.

On occasions two other complications may result as a consequence of a short cord—viz., detachment of placenta and inversion of uterus (p. 568).

Although it has been suggested that the condition may be diagnosed by the presence of the funic souffle (p. 741) and recession of the presenting part in the intervals between the pains, we have only found it possible to appreciate this complication while actually extracting the child and experiencing difficulty in doing so.

Undue Thickness.—The thickness of the cord varies greatly. In some instances it is very bulky, owing to the large amount of Wharton's

jelly. Very thick œdematous cords are often encountered in general œdema, syphilis and other diseases of the fœtus.

Exomphalos.—Here is probably the most suitable place for a reference to a complication not extremely uncommon—viz., an umbilical hernia (exomphalos), where the intestines pass through the umbilical opening and are surrounded by a ballooned-out portion of the cord. Where this hernia is very pronounced there is not much chance of the condition being overlooked, but where there is only a small hernia and slight ballooning of the cord it may be very easily overlooked and mistaken for an ordinary thickening of the cord. The condition is more fully considered in Chapter XXXV (p. 626).

Knots in the Cord.—These are often referred to as: (a) false knots; and (b) true knots. False knots are merely irregular projections of blood-vessels and Wharton's jelly, and are of no consequence. True knots (Fig. 200), on the other hand, may seriously affect the child and even cause its death if they become tightened and the circulation in the cord is obstructed: generally an accumulation of Wharton's jelly prevents constriction of the vessels. Knotting of cords in twin pregnancy is illustrated on previous page.

Rupture of Cord.—This accident occasionally occurs in "precipitate labour" (p. 432), more especially if the birth occurs with the mother in the erect posture, and if there is relative shortness of the cord. Curiously enough, the rupture usually occurs some little way from the umbilicus. Very seldom indeed is the cord actually torn from its attachment. With rupture of the cord there may be considerable bleeding, but as the vessels are torn the bleeding is not so great as might be expected.

B. MEMBRANES

We shall consider later the most common complication connected with the membranes—viz., "Retention of Membranes" (p. 553). Diseases of the membranes and placenta were considered in Chapter XV (p. 305). For the present reference will only be made to those occurring at an earlier stage of labour or late in pregnancy.

Premature Rupture.—We have seen already that this occurrence is sometimes associated with a slow and painful dilatation of the cervix and that the child life in consequence may be endangered. The parturition is generally referred to as "dry labour." It is particularly common in breech presentations, in other malpresentations and in pelvic disproportion. At one time it was considered a very unfortunate occurrence, but it is not now looked upon with a like concern.

Occasionally rupture of the membranes occurs several weeks before term. Indeed, there is a rare condition known as "pregnancy outside the membranes (*grossesse extramembraneuse*)," where rupture occurs very early and the remains of the retracted membranes are seen encircling the placenta (Fig. 202). In this condition the child is

generally born dead ; but occasionally it is born alive, in which case it is feeble and poorly developed.

This leads us to make reference to a peculiar complication of pregnancy—viz., *Hydorrhœa gravidarum*—the discharge of a clear limpid fluid at irregular intervals. This may result from (a) discharge of liquor amnii from the ruptured membranes, (b) from a collection of fluid between the decidua vera and decidua capsularis, the result of chronic inflammation of the decidua. (c) It is claimed also that an accumulation of fluid may occur between the chorion and amnion



FIG. 202.—Complete Rupture of Membranes but Continuance of Pregnancy
(*Grossesse extramembraneuse*).

(*hydroperione* of Velpeau) and the discharge of fluid occurs if chorion gives way. Probably (a) is the commonest explanation. Where (b) is the cause, the story may be of a ten days' or a fortnight's interval between the occurrence of the discharge. Further, the patient states very often that she has a certain amount of uneasiness prior to the discharge, and that the uneasiness passes off after the fluid comes away. Lastly, the freedom of movement of the fœtus *in utero* is not affected. The condition (c) is very doubtful.

Delayed Rupture.—This condition has been already considered (p. 405). We have seen that if the membranes are unusually thick or tough, their rupture may not occur as it should do at the end of

the first stage of labour. The treatment is very simple—viz., to rupture them with some pointed instrument. It is advisable to do this during a uterine contraction, for then the projecting bag of membranes (fore-waters) can be more easily punctured.

Hydramnios.—This condition has been discussed under Pathology of Pregnancy (p. 305). Encountered during labour it may interfere with the normal dilatation of the cervix, and, further, may be associated with primary uterine inertia. It is, however, very easily dealt with, for rupture of the membranes immediately causes retraction of the uterus and a more rapid progress of the labour. One must be on the outlook and prepared to deal with malpositions of foetus, which is generally undersized and very frequently malformed. Twin pregnancy is common (p. 494). Postpartum hæmorrhage is an occasional sequela (p. 560).

CHAPTER XXX

DYSTOCIA DUE TO FAULTS IN THE PASSAGE—DEFORMITIES OF THE BONY PELVIS

Classification—Diagnosis—Treatment—Minor Variations in Pelvic Formation revealed by Radiography

FOR many generations obstetric textbooks have presented to their readers a classification and description of what may be termed the *grosser malformations* of the female pelvis (many of great rarity) based upon an examination of dried pelvises in anatomical and obstetrical museums. These textbooks have pointed out also the significance of such malformations as a cause of obstruction to labour, the manual and instrumental methods by which they can be recognised during life, and the treatment most suitable in the circumstances.

In recent years, however, a great advance has been made. By means of radiography it has become possible not only to demonstrate more clearly in the living subject the grosser malformations present, and to measure more exactly the pelvic capacity, but also to recognise the frequent existence of *minor variations of pelvic formation* in individuals who might otherwise be supposed to possess a normal pelvis. The significance of this new discovery (one can almost term it such) is being much discussed to-day by obstetricians. It would appear that these minor variations may exercise a considerable influence on the mechanism of labour, more especially in inducing alterations in position and attitude of the foetal head (occipito-posterior, “deep transverse arrest,” face and brow presentations).

We propose, therefore, to consider the subject in respect to classification, diagnosis and treatment under two main heads: *A. Grosser Pelvic Malformations*; *B. Minor Variations in Pelvic Formation*. We consider this to be the simplest manner of presenting the subject.

A. GROSSER PELVIC MALFORMATIONS

The two principal factors which influence pelvic deformity are (a) errors of development; (b) disease of the pelvic bones and joints. As, however, alterations in the spinal curves or set of the lower limbs may affect the direction of the forces transmitted through the pelvis while it is still growing, pelvic deformity is sometimes produced

or aggravated by (c) abnormalities in spine; (d) abnormalities in lower limbs.

With a view to making the classification as simple as possible, we suggest the following :—

I. Deformities resulting from faulty development : (a) justo-major pelvis ; (b) justo-minor pelvis, or generally contracted pelvis and its variants ; (c) simple, flat, non-rachitic pelvis ; (d) Nægele's pelvis, imperfect development of one sacral ala ; (e) Robert's pelvis, imperfect development of both sacral alæ ; (f) split pelvis, imperfect development of pubes ; (g) assimilation pelvis.

II. Deformities resulting from disease of the pelvic bones and joints : (a) rickets ; (b) osteomalacia ; (c) new growths ; (d) fractures ; (e) atrophy, caries and necrosis ; (f) disease of sacro-iliac, pubic and sacrococcygeal joints ; (g) subluxation of sacro-iliac joint.

III. Deformities resulting from disease in spinal column : (a) kyphosis ; (b) scoliosis ; (c) lordosis ; (d) spondylolisthesis.

IV. Deformities resulting from disease of the lower extremities : (a) coxitis ; (b) dislocation of one or both femora ; (c) atrophy or loss of one or both limbs.

I. DEFORMITIES RESULTING FROM FAULTY DEVELOPMENT

Justo-major Pelvis.—This pelvis in its extreme form, which is very rare, is found in giants. Moderate degrees of the condition are occasionally encountered, and not always amongst those of unusual height or physique. A roomy pelvis renders the passage of the head more easy, and favours precipitate labour.

Justo-minor or Generally Contracted Pelvis.—This deformity is by no means uncommon. The term implies that the pelvis is equally diminished in all its diameters ; *but radiography has demonstrated that minor variations of pelvic formation are more common than a symmetrical general contraction* (pp. 534-538).

It is commonly stated that the existence of the generally contracted pelvis should be suspected in women of small stature, in whom there is no evidence of rickets. Although this is correct on the whole, it is sometimes misleading ; for the deformity is often present, and sometimes to quite a distinct degree, in women of ordinary height and physique ; it is consequently liable to be overlooked.

The interspinous, intercrystal, and external and oblique conjugate diameters are decreased proportionately. As the deformity continues down through the cavity, and indeed in many cases is most marked at the outlet, the size of the subpubic angle should be carefully estimated, for, speaking generally, the greatest difficulty in the parturition occurs at the outlet.

On pushing the head into the pelvis, if the pregnancy has reached term, there is more or less overlapping of the head at the brim. At the

commencement of labour, even in primiparæ, the head is still movable, unless the latter is small.

The mechanism of labour is characteristic, the feature being a marked increase of flexion caused by the increased resistance offered to the head. As a result the posterior fontanelle can be felt very easily on making a vaginal examination.

The labour is retarded in proportion to the pelvic deformity and the position and size of the fœtal head. Uterine inertia frequently occurs, and delivery has often to be completed by forceps, or even by Cæsarean section. Walcher's position (p. 531), sometimes a help in flat pelvis, is of no value in facilitating the passage of the head through the brim. Version is contraindicated (*vide* Treatment, p. 528).

There are several subdivisions of the generally contracted pelvis. The most common is the *masculine pelvis* (android, p. 536), in which the

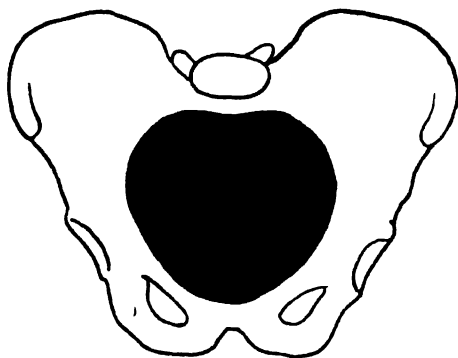


FIG. 203.—Justo-minor Pelvis.

bones are strong and thick. In this variety, in addition to the deformity at the brim, there is a marked diminution in the size of the outlet, and the subpubic angle is narrowed. The pelvis becomes *funnel-shaped*, and is often referred to under this name. Another form is the *true dwarf pelvis*. In this variety the general pelvic development is much retarded, and in certain forms the cartilages between the component bones (ileum,

os pubis, ischium) are not ossified. Lastly there is the *infantile pelvis*, in which the pelvis retains the infant form. The bones are small, the sacrum is narrow, and the antero-posterior diameter is greater than the transverse. Pregnancy rarely occurs in the true dwarf and infantile pelvis.

Flat Non-rachitic Pelvis.—In this pelvis the antero-posterior diameter is diminished from brim to outlet. The sacrum is flattened and placed further forward. The promontory does not project so markedly as in the rachitic flat pelvis, and there is often a false promontory at the junction of the first and second sacral vertebræ. The transverse and oblique diameters are unaltered, or may even be slightly increased. The deformity not infrequently coexists with the "assimilation" pelvis (p. 512).

Although referred to by many as being a comparatively common deformity, it is very questionable if it is so; most of the so-called flat pelvises have their origin in rickets. This pelvis is found in individuals who apparently are perfectly normal and healthy, and have always been so.

The diagnosis of this variety of pelvic deformity is not difficult. It can be distinguished from the rachitic variety by the absence of the ordinary features of rickets and by the flatness of the sacrum. The engagement of head is as in the flat rachitic pelvis (p. 514); but the pelvic outlet not being increased, as it is in the rachitic variety, the head remains arrested in the transverse diameter ("deep transverse arrest," p. 448).

Obliquely Contracted or Nægele Pelvis.—This somewhat rare variety of pelvic deformity (Fig. 204) is produced by an arrested development of one ala of the sacrum—(a) primary, or (b) secondary to disease of sacro-iliac joint in infancy. There follows from this an alteration in the spinal and pelvic curves, and almost invariably an ankylosis of the sacro-iliac joint. The most striking feature is the straightening of the ilio-pectineal line on the affected side. The symphysis is pushed an inch or more beyond the middle line. The antero-posterior diameter is little affected, but the oblique and transverse are diminished.

The difficulty in labour arises from the sacral "bay" on the affected side being of little value in accommodating any part of the foetal head. Indeed, for all practical purposes the pelvis may be extremely contracted.

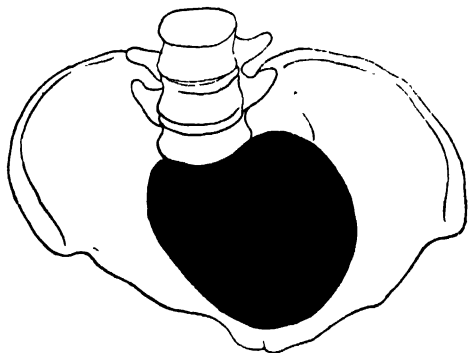


FIG. 204.—Nægele Pelvis.

As a rule, the ordinary pelvic measurements throw little light upon the deformity, nor is the gait of the patient characteristic, so that it may not be appreciated except by radiography. The measurements which should be taken are the distances between the symphysis and the posterior superior spines, between the spinal column and the posterior spines, and between the anterior superior spine and the opposite posterior superior spine. These measurements on the two sides should be compared, and, if a difference of more than $\frac{1}{3}$ inch (0.83 cm.) be found, an oblique deformity may be presumed. A radiograph is of the greatest assistance. Cæsarean section is the only alternative if there is pronounced deformity.

Transversely Contracted or Robert's Pelvis.—This has sometimes been referred to as a double Nægele pelvis, for both alæ of the sacrum are more or less ill developed (Fig. 205). The deformity may be symmetrical or more accentuated on one side. It is the rarest of all the pelvic deformities. As the cavity throughout is so very much narrowed transversely it is impossible to deliver a living child *per vias naturales*; consequently, Cæsarean section is the only treatment if the child is alive.

Split Pelvis.—This variety is extremely rare in obstetric practice. The pubic bones may be separated as much as 4 inches; they are united by fibrous tissue. If pronounced it is commonly associated with ectopia of the bladder and other malformations of the generative

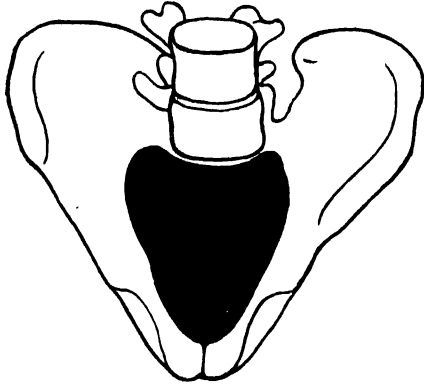


FIG. 205.—Robert's Pelvis

and urinary organs. The transverse diameters are increased. The condition is not incompatible with a normal pregnancy and labour.

Assimilation Pelvis.—This deformity is of two varieties: (a) *high assimilation*, in which the last lumbar vertebra becomes part of the sacrum, which then consists of six instead of five vertebrae; (b) *low assimilation*, in which the first sacral vertebra takes on the form of the last lumbar vertebra, and so the sacrum consists of only

four vertebrae. *These errors of development are not uncommon, but can rarely be recognised during life except by radiography.* In high assimilation the inclination of the plane of the pelvic brim is greater than the normal of 60° —this obviously interferes with the head of the child entering the brim. With a low assimilation the angle of inclination is less than the normal, and so the head may engage more easily. High assimilation pelvis predisposes to an occipito-posterior position of the vertex (p. 439).

II. DEFORMITIES THE RESULT OF DISEASE OF THE PELVIC BONES AND JOINTS

In this country, and in temperate climates generally, rickets is the chief factor in the causation of pelvic deformities. But although rickets is so generally distributed over the continents of both Europe and America it is more prevalent in certain countries than in others, and generally speaking, it is a disease of large cities. It would appear that the ætiology of rickets and osteomalacia is very similar—a deficiency in calcium and vitamin D. Mellanby claims (p. 517) that in the case of osteomalacia there is a deficiency of phosphorus. Glasgow possesses the unenviable distinction of being one of the cities in which the disease is especially common—its water is very deficient in calcium.

Deformities the Result of Rickets.—In obstetric practice one meets with three varieties of pelvic deformity the result of rickets: (a) flat rachitic pelvis; (b) generally contracted rachitic pelvis, usually also flat; (c) pseudo-malacosteon pelvis.

(a) *The Flat Rachitic Pelvis.*—This is the commonest variety of pelvic deformity produced by rickets. In order to understand it

properly one must think of the time when the child was the subject of the disease. Rickets affects children most commonly during the second year, when the child is either sitting or attempting to walk, or, if very ill, is lying or sitting in bed. In the sitting position the weight of the trunk is transmitted through the pelvis on to the ischial tuberosities, and the pelvic bones, being softened by disease, are deformed as follows:—The promontory of the sacrum, owing to the weight of the trunk, is displaced downwards and forwards. This would naturally cause a tilting backwards of the lower part of the sacrum and coccyx, were it not that the sacro-sciatic ligaments and muscles of the pelvic floor prevent it; instead a sharp bending of the sacrum at the level of the fourth and fifth sacral vertebræ results.

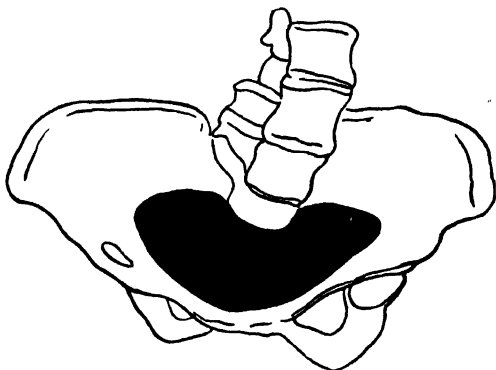


FIG. 206.—Flat Pelvis.

Occasionally sacrum and coccyx are flattened as in the non-rachitic flat pelvis. With the sinking of the sacrum the posterior spinous processes are dragged closer by the sacro-iliac ligaments, and this and the dragging and flattening of the anterior pelvic wall causes a relative increase of the interspinous as compared with the intercrystal diameter. The former,

instead of being about $\frac{3}{4}$ inch less, may be the same as, or even greater than, the latter. Further, as a result of the flattening of the anterior wall, the acetabula come to look more forward.

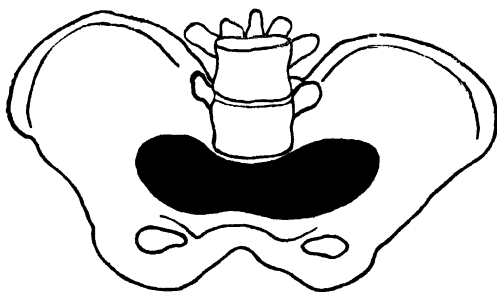


FIG. 207.—Figure-of-eight Pelvis (Rachitic Pelvis).

But there is still another striking feature. The tuberosities of the ischia, on which the child sits, yield, and are

pressed farther out, so that there is an increase of the distance between these two points and a widening of the subpubic angle; in consequence, the transverse diameter of the outlet is increased.

Examination of the pelvic brim reveals the promontory of the sacrum unusually distinct, sometimes very pointed, at other times more blunt; this gives to the brim a reniform outline (Fig. 206). In addition, if the anterior wall at the symphysis is dragged on by the action of the two rectus muscles, and these latter come into strong action if the child is sitting, the brim may assume a *figure-of-eight* form (Fig. 207).

If there is any marked lateral spinal curvature the promontory is pushed over to the side, and the *scoliotic-rachitic* pelvis results (Fig. 208). This latter form is much more common than is usually stated, for frequently it is only slightly marked and difficult of recognition. In some cases it is very distinct, and interferes greatly with the passage of the foetal head through the brim.

The flattening of the pelvis produces a narrowing of the antero-posterior diameter, or conjugata vera. It may be reduced to any extent—the most extreme degree the writer has encountered is $1\frac{1}{4}$ inches (3 cm.). The effect on the transverse diameter at the brim depends upon whether or not there has been any arrest of the general development of the pelvis. If the disease was only slight, the transverse diameter remains about the same. Although it is stated that there is sometimes an actual increase, we have seldom observed this ;

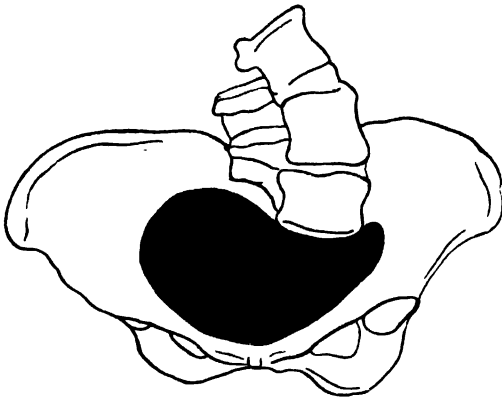


FIG. 208.—Scoliotic rachitic Pelvis.

invariably when the flattening is decided the transverse diameter is also diminished.

A peculiarity not infrequently encountered is a false promontory. There are two varieties of *false promontory*—one where the last lumbar vertebra is pushed downwards and forwards, and the other where the first sacral vertebra projects unduly. They are often termed “high” and

“low” false promontories. A high false promontory increases the obliquity of the pelvic brim, consequently the head has greater difficulty in “engaging.”

The cavity is usually shallow and roomy, so that once the head passes through the brim it is seldom arrested in the cavity. At the outlet there may be sometimes a little difficulty ; for, although the transverse diameter is increased, as already pointed out, the dragging of the coccyx forwards may diminish the conjugate to a slight extent and cause “deep transverse arrest” (p. 448) of the head.

In the mechanism of labour in flat pelvis, either rachitic or non-rachitic, there are three characteristic features :—

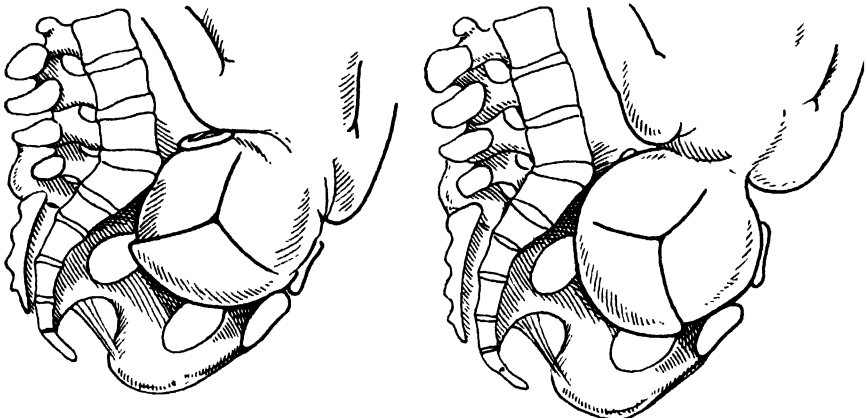
1. The head engages in the transverse diameter.
2. The head is less flexed.
3. Biparietal obliquity is more marked.

It is only natural that the head should pass through the brim in the transverse diameter, which is so much the largest. If a vaginal examination is made the anterior fontanelle can be readily reached,

and is usually lower, although occasionally it may be at the same level as the posterior because of deflexion of head. But the most striking alteration in attitude is an increase in the parietal obliquity. The head is tilted towards one or other shoulder, with the result that the anterior or posterior parietal bone presents—this is termed *asynclitism*.

In the *anterior parietal presentation* (*asynclitismus anterior*), the parietal bone, directed posteriorly, is arrested by the promontory of the sacrum. It is an exaggerated degree of what is termed “Nægele’s obliquity.” The descent of the head takes place by the anterior parietal bone becoming pressed against the symphysis pubis, while the posterior is gradually driven down past the promontory. It is a very much more favourable position than the posterior; indeed, in a large number of cases spontaneous delivery occurs.

In the *posterior parietal presentation* (*asynclitismus posterior*),



Anterior (Anterior asynclitism).

Posterior (Posterior a-synclitism).

FIG. 209.—Parietal Presentation.

Litzmann’s obliquity is exaggerated, and it is the anterior parietal bone which is arrested at the symphysis, while the posterior engages in the brim. The mechanism, according to Litzmann, was for a gradual correction to take place, but Veit showed that the head might pass through the brim by the anterior parietal bone becoming much moulded and forced past the symphysis. Spontaneous delivery is rare in this presentation, unless the pelvis is only slightly deformed. A posterior parietal presentation should always arrest attention, for not only is the presentation particularly unfavourable, but the degree of pelvic deformity is usually considerable if the head persists in this attitude as labour progresses.¹

¹ Radiography has shown that early in labour when engagement starts the head assumes a position of slight posterior asynclitism. This disappears and an anterior asynclitism develops if the head is going to pass through the brim. On the other hand, if the original posterior asynclitism becomes more pronounced the head will not pass. In the latter event the overlap of head at the brim can be felt to increase by palpation; this, of course, is more exactly demonstrated by radiography (*vide* p. 391).

We have repeatedly tried to correct a posterior into an anterior parietal presentation after rupture of the membranes, but with little success ; and this is the general experience.

(b) *Generally Contracted Rachitic Pelvis*.—The majority of cases of marked pelvic deformity come under this heading. In an absolutely typical example flattening is absent, but with very few exceptions there is flattening as well as general contraction. The explanation of the deformity is that the disease has arrested the pelvic development. The patients may be very small and much deformed in limbs, chest, etc. General contraction of the pelvis is much more serious than simple flattening. Consequently it is most important in all cases of rachitic deformity to determine if there is any general contraction in addition to flattening—this can be exactly determined by radiography.

(c) *Pseudo-malacosteon Rachitic Pelvis*.—This variety of pelvic deformity is very rare. It occurs when the disease has run a slow

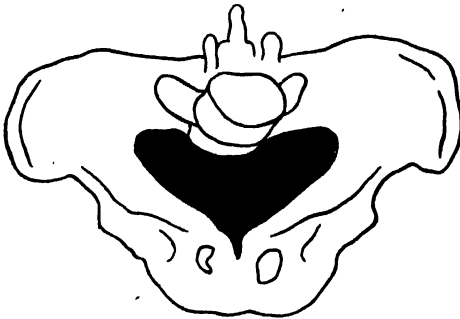


FIG. 210.—Pseudo-malacosteon Pelvis.

course and has attacked the walking child. As a natural consequence, the weight of the child being supported by the femora instead of the ischial tuberosities, the sides of the pelvis are pushed in, and the anterior wall projects in the form of a beak. A similar deformity is seen in the malacosteon pelvis, only to a more marked extent, hence the term

“pseudo-malacosteon pelvis” given to this variety of rachitic deformity (Fig. 210). Knowing as we now do that the ætiology of the two diseases is very similar, it may be possible in the future to exclude this particular deformity from the rachitic group. The distortion of the brim, cavity, and outlet of the pelvis is generally so pronounced in this type that Cæsarean section is the only method of treatment.

Osteomalacic or Malacosteon Pelvis.—This deformity of the pelvis results from the disease osteomalacia. The disease is one of adult life, and attacks both sexes, although women are affected ten or twelve times as often as men. In women it is confined almost entirely to multiparæ in the period of life when the reproductive organs are functioning. It is specially active during pregnancy and the puerperium. A most interesting feature of the disease is the fact that it is prevalent only in certain localities, for example, areas of the Rhine Valley, north of Italy, Hungary, Northern China, and some parts of India ; it is seldom seen in England, America, and France.

Important papers on the subject have been published by Preston Maxwell and Miles, and by Green Armytage. It is now recognised

that the disease is due to a deficiency diet, the principal lack being a shortage of the mineral content and vitamin D. Mellanby stresses the importance of a phosphorus deficiency. Lack of sunlight and fresh air are contributory factors in its production. Possibly also deficiency in the activity of the parathyroids may be a factor.

The onset of the disease is, as a rule, gradual. During the course of pregnancy, usually after one or two normal pregnancies, pains are complained of in the back and limbs, and walking becomes irksome. These symptoms may disappear after labour and lactation, to return again with increased severity in a subsequent pregnancy. With each pregnancy locomotion becomes more awkward, the patient's stature becomes less from sinking of the trunk,

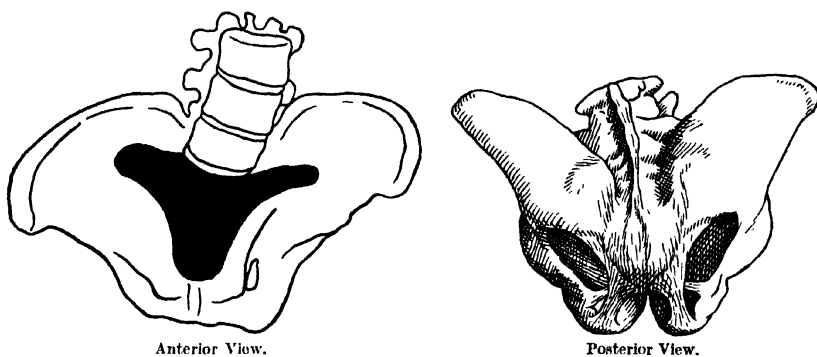


FIG. 211.—Malacosteon Pelvis.

and the labours become more difficult from narrowing of the bony canal.

The bones, as a result of the softening, bend, according to the direction of the forces transmitted through them and the drag of the attached muscles on them. In no pathological condition of the pelvis does one meet with such extreme deformity as in osteomalacia (Fig. 211). The promontory is pushed downwards and forwards: the lateral pelvic walls, being pressed inwards, cause the anterior wall to be pushed out in the form of a beak, and the brim assumes a trifoliate shape. Hence the pelvis is often spoken of as the *beaked*, *rostrate*, or *triradiate* pelvis. The subpubic arch is very much narrowed, from the approximation of the ischial tuberosities. The acetabula look more forward, and the legs are brought closer together, so that the subjects of the disease, if they can walk, have a peculiar swinging gait. From the muscles and ligaments dragging on their attachments, a marked curving of the iliac crests and posterior parts of the innominate bones results, so that the posterior spinous processes may almost touch. Thus the iliac bones become curved and resemble the "scoop" used by grocers. The upper and lower limbs may also become much deformed.

The diagnosis of this variety of pelvic deformity is not difficult. The history of the disease and the deformities produced are absolutely characteristic.

Prior to Fehling's discovery (1888) that oöphorectomy exercised such a beneficial effect upon the disease, the salts of lime and phosphorus in various forms were recommended. The treatment to-day consists in giving the patient a plentiful supply of a diet rich in vitamin D, and cod-liver oil is specially useful. By this means the disease can be prevented, and arrested in many instances (p. 147). As regards purely obstetrical treatment, Cæsarean section, with removal of uterus and ovaries, should be adopted in all pronounced examples of the disease. In the slighter forms simpler procedures may prove sufficient, but owing to the nature of the deformity it can be readily

understood that it does not require any great malformation to render delivery *per vias naturales* impossible.

New Growths.—Small osteomata (*pelvis spinosa*), more especially about the symphysis, sacro-iliac synchondroses, and the ileo-pectineal eminences, are not very uncommon. Such small growths, if the pelvis is contracted, may cause injuries to the foetal head such as gutter-shaped in-

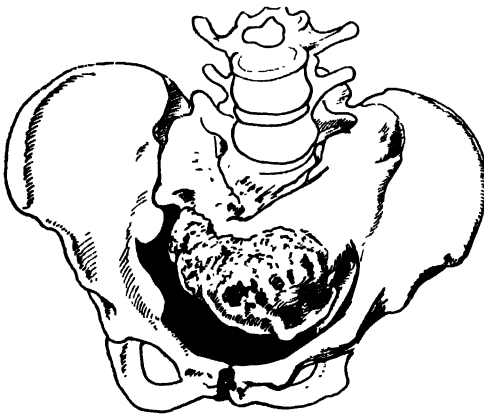


FIG. 212.—Tumour of Pelvis.

dentations and fractures, or lacerations of the uterus from pressure by the head.

Larger tumours (Fig. 212)—osteomata, enchondromata, lymphadenomata, fibromata—are only very occasionally encountered. With the exception of the osteomata, they are generally malignant, and most commonly sarcomatous. They are usually situated on the posterior wall in the neighbourhood of the sacro-iliac synchondrosis. Naturally, such tumours prevent the passage of the child through the pelvis, and so Cæsarean section is invariably necessary.

Fractures of Pelvis.—As can be readily understood, fractures, either from the amount of callus or from irregular union, may occasionally produce a deformity of the pelvis. Such deformities are relatively rarely encountered, for fracture of the pelvis is so often followed by death.

Caries and Necrosis of the Pelvis.—In the rare cases in which the acetabulum becomes perforated in hip-joint disease there may result an irregular bony formation, which may encroach upon the lateral pelvic wall. The effect of hip-joint disease on the pelvis we shall consider later. Caries of the sacro-iliac joint may result in an ankylosis

of the joint, and the development of one sacral ala may be arrested in consequence. In such cases an obliquely contracted pelvis of the Nægele type results.

Diseases of the Sacro-iliac, Pubic and Sacrococcygeal Joints.—We have referred already to the effect of disease and ankylosis of the sacro-iliac joint. Ankylosis of the pubic joint is practically unknown. *Subluxation of the sacro-iliac joint*, which occurs in women of the working class more especially, may affect the pelvic cavity.

As regards the coccygeal joint, premature ankylosis, or ankylosis following fracture, may cause obstruction to the escape of the child's head. Removal of the coccyx is the correct and scientific treatment. A common course followed is to pull the child past the obstruction with forceps which results in refracture of the bone—this is obviously a crude and wrong procedure.

III. DEFORMITIES RESULTING FROM DISEASE IN THE SPINAL COLUMN

Kyphosis.—The deformity of the pelvis found in kyphosis depends in great part, upon the degree and situation of the curvature.

In cases where there is only a slight angular curvature little or no alteration in the pelvis is found.

As regards situation, if the curvature is in the upper dorsal region, a compensatory lordosis develops, and the pelvis is little affected. If, however, the curvature is situated in the lower dorsal and lumbar part of the spinal column, then very decided deformity almost always exists (Fig. 213).

The alteration in the pelvis consists in a tilting of the upper part of the sacrum backwards, and of its lower part and of the coccyx forwards. As a result, the antero-posterior diameter at the brim is increased, and the same diameter at the outlet diminished. The inclination of the brim is lessened. The sacrum is often found narrow and straightened. The transverse diameter of the pelvis gradually diminishes from above downwards.

The striking features of the kyphotic pelvis are—(a) an increase of the antero-posterior diameter at the brim ; (b) a diminution of the transverse

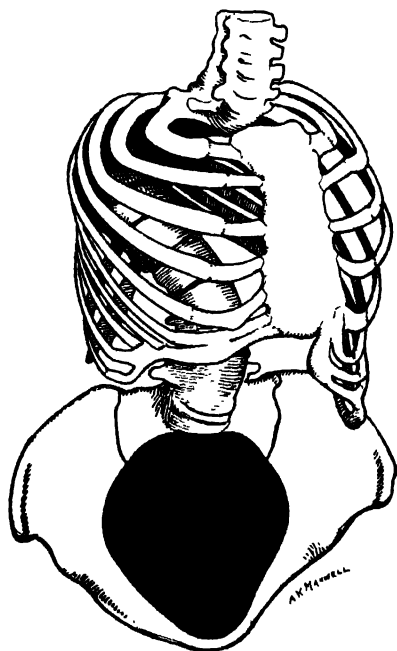


FIG. 213.—Kyphotic Pelvis.

diameter of the outlet ; therefore, one finds difficulty in labour when the foetal head has reached the lower part of the cavity.

It is of interest that the head generally engages in the oblique or transverse diameter—one might expect that it would engage in the conjugate, as this is the diameter which is increased. The spinal curvature probably accounts for it (*vide* p. 439). Another peculiarity is the frequency with which the occiput rotates backwards into an occipito-posterior position.

It is most important, therefore, that the *size of the pelvic outlet should be very carefully estimated and a radiograph taken during pregnancy, or early in labour, in all cases of kyphosis.*

The malformation is serious when the deformity involves the lower part of the spinal column. One thing that undoubtedly leads to the unsatisfactory results revealed by most statistics is the fact that, as the difficulty occurs late in parturition, the necessity for serious operative interference is only appreciated after labour has been going on for some time. But other factors account for the relatively high maternal death-rate—the mother is generally of poor physique, and is often the subject of bronchitis, anæmia, or cardiac dilatation. These conditions account also for the weakness and low weight of the children.

The index for treatment in kyphotic pelvis is the length of the transverse diameter of the outlet, the distance between the tuberosities. If it is $3\frac{1}{2}$ inches (9.3 cm.), delivery should not be difficult, but below that figure it becomes increasingly difficult, and at 3 inches (7.5 cm.) Cæsarean section or symphysiotomy if the child is living, and craniotomy if it is dead, is the treatment indicated. Symphysiotomy is specially suitable for this condition when the deformity is pronounced (*vide* p. 715).

The fact that the children are often small and ill-nourished, as already mentioned, should be borne in mind if much force is employed in extracting the child.

In a very few extreme examples of this deformity the lower part of the spinal column actually projects over the sacrum ; this variety has been named *pelvis obtecta* (Fehling).

Scoliosis.—Lateral curvature of the spinal column, to any very marked extent, is usually of rachitic origin : if non-rachitic it may be negligible from the obstetric standpoint.

The scoliotic-rachitic pelvis has been already mentioned (p. 514), and its importance as influencing the passage of the head through the brim has been referred to. A curvature high in the spinal column will not have the same effect as one situated low down, for a compensatory scoliosis occurs in the former. The feature of the malformation is a displacement of the promontory towards the affected side, so that the pelvic brim is of extremely irregular outline. Should the occiput be directed to the narrower side it may be impossible for the head to enter the brim as it may cause a face or brow presentation.

Spondylolisthesis.—This is a slipping down of the last lumbar

vertebra in front of the promontory. In slight cases it only projects a little way over the promontory, but in extreme cases it projects down in front of the first sacral vertebra (Fig. 214). The remaining lumbar vertebræ also sink down, and the fourth and third may actually project over the superior strait, but seldom to the extent that occurs in the *pelvis obiecta*, referred to on previous page.

It can be readily understood that the deformity causes great alteration in the pelvic capacity. The promontory is displaced backwards, but the "obstetric conjugate," the distance between the symphysis and the most projecting part of the vertebral column, is very much lessened. The sacrum being pushed backwards and the lower lumbar vertebræ downwards, the superior strait becomes more horizontal. The pelvic outlet becomes diminished antero-posteriorly.

The appearance of subjects with this deformity is quite characteristic; the trunk appears telescoped into the pelvis. The diagnosis, therefore, should seldom be difficult, although there are other conditions, such as osteomalacia and a low kyphosis, which produce a sinking down of the trunk. By internal examination the projecting vertebra can be readily felt, and by radiography an exact picture obtained.

Genuine spondylolisthesis is the result of maldevelopment of the interarticular processes of the lower lumbar vertebræ. In slight examples subluxation of vertebral joints in pregnancy and occupational strain may be the cause. The frequency of the condition is variously stated—the discrepancy is probably because some include the slighter cases of projection of the last lumbar vertebra, while others only accept extreme cases. As we have seen (p. 514), the last lumbar vertebra is sometimes pushed forwards and downwards in the rachitic pelvis—if such cases are included the frequency would certainly be much higher than is generally stated.

In the slighter degrees it may be possible to deliver the child *per vias naturales*. Cæsarean section if the child is alive, or craniotomy if it is dead, is the only possible treatment in pronounced examples of this deformity.

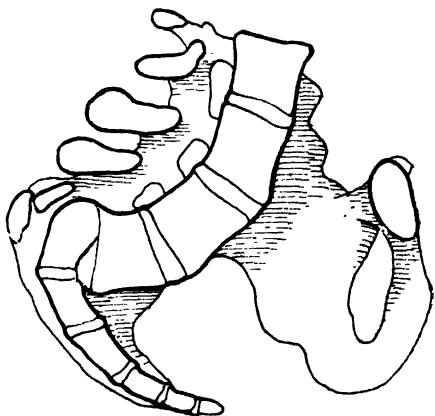


FIG. 214.—Spondylolisthetic Pelvis.

IV. DEFORMITIES FROM DISEASES OF THE LOWER EXTREMITIES

The deformities resulting from disease of the lower limbs are usually unilateral. Coxalgia, dislocation, and shortening of the leg from any

cause, of which infantile paralysis is probably the most common, are the chief affections encountered. The deformity resulting from each of these conditions is much the same, although in coxalgia it is usually most marked.

In hip-joint disease, if the child is very young and the development of the affected side is partly arrested, an ankylosis of sacrum and ilium may result. As the child goes about, however, and most of the weight is thrown on the sound leg, an oblique distortion of the pelvis follows. The deformity is seldom so great as to necessitate Cæsarean section.

In the case of congenital dislocation of the femur, or a dislocation occurring in early life, the head of the bone is displaced on to the ilium, where a new joint forms. The affected leg being shortened, the greater part of the body-weight is borne by the sound leg, and consequently that side of the pelvis is pushed in. In the rare condition of congenital dislocation of both femurs both sides are pushed in, and the brim narrowed transversely. In such cases Cæsarean section is generally necessary. Similar but less marked deformities may follow shortening or absence of a limb from any cause if it occurs in early life. In all these conditions a radiograph of the pelvis should be taken.

As the obstruction may be especially at: (a) brim, (b) outlet, we deem it advisable to discuss diagnosis and treatment under these two heads.

(a) OBSTRUCTIONS MORE PARTICULARLY AFFECTING THE PELVIC BRIM

Diagnosis.—A suspicion of pelvic deformity is aroused by smallness

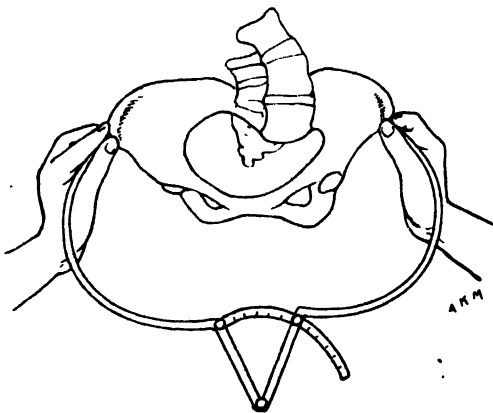


FIG. 215.—Measuring the Interspinous Diameter. Here is a scolio-rachitic pelvis with interspinous and intracristal diameters equal (p. 513).

of stature, unusual gait, malformation of limbs or spine, and, in the case of a primigravida, a pendulous abdomen. Occasionally, however, a quite distinct pelvic malformation exists although there are none of these conditions present. Conversely, we sometimes find that the degree of pelvic deformity is not so pronounced as external appearances would lead one to expect. Lastly, routine radiography has demon-

strated that minor degrees of disproportion (p. 534) exist in a considerable proportion of women.

The external measurements of the pelvis are taken with calipers. The routine measurements are the intercrystal, interspinous and

external conjugate diameters, which measure respectively $10\frac{1}{4}$, 10 and $7\frac{1}{2}$ inches (26·8, 25 and 18·7 cm.) (p. 6). The exact terminal points of the *interspinous* diameter are easily defined—viz., the anterior superior spinous processes (Fig. 215). With the *intercrystal* diameter it is rather different. The terminal points of this diameter are the widest points on the crests. But the crest is a bony ridge of some thickness, and it makes a considerable difference if one measures from the outside or the inside of the ridge. To ensure uniformity and exactness always measure from the middle, and place thumb and middle finger on the inside and outside edge respectively of the bony ridge.

The *external conjugate*, known as Baudélocque's diameter (Fig. 216)—the distance between the points immediately below the projecting

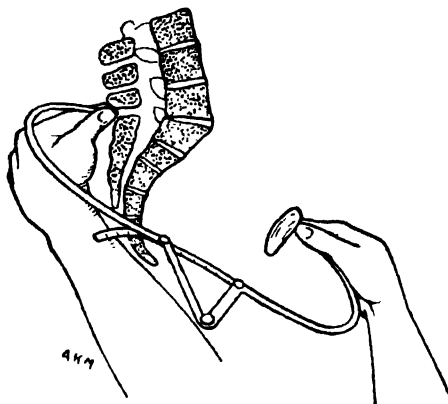


FIG. 216.—Measuring the External Conjugate.

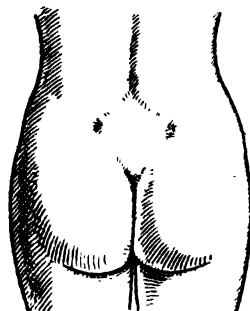


FIG. 217.—Showing Michaelis' rhomboid.

spine of the last lumbar vertebra and the symphysis pubis—is less easily measured because of the difficulty in marking off the posterior point. In certain individuals, however, this may be overcome by taking the upper angle of a small rhomboid found often at the lower part of the vertebral column, and known as *Michaelis' rhomboid* (Fig. 217). This latter point very nearly corresponds to the point desired. There is, however, no constant relationship between the external conjugate and the internal or true conjugate of the brim, although, on an average, the difference is about $3\frac{1}{2}$ inches (8·7 cm.). Pelvic deformity should, however, always be suspected if it measures 7 inches (17·5 cm.) or under.

From these external measurements one can estimate, but only approximately, the formation of the true pelvis. Approximately, but only approximately, the transverse diameter of the brim is half the intercrystal diameter. If one finds all the diameters about equally diminished, a generally contracted pelvis is surmised, while if the external conjugate only is altered, a flat pelvis is

suspected. The measurements which should be taken in the rarer forms of pelvic deformity have been referred to when each was considered.

In order to arrive at *the exact internal measurements* of the pelvis, endless devices and many forms of pelvimeter have been suggested. Without exception, these instruments have proved of little practical value, and are now only of historical interest. Although much may be learned in respect to the size and formation of the pelvis by simple mensuration with calipers and by the hands, pelvic radiography (Chapter LX) has supplanted internal pelvimetry by hands and instruments if absolute exactness is desired.

The skilled obstetrician, who has had an extensive experience of deformed pelves, can estimate fairly correctly the pelvic capacity by

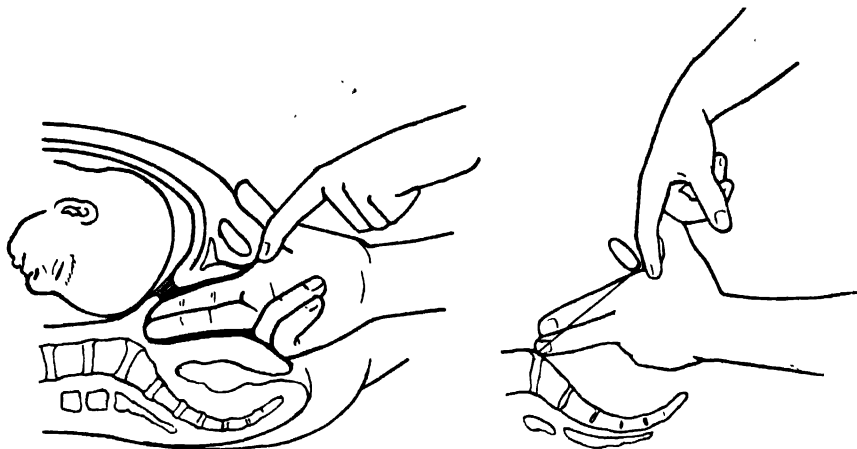


FIG. 218.—Measuring Oblique or Diagonal Conjugate.

means of his fingers, and certainly the chances which the foetal head has of passing through ; but he cannot put down on paper its exact measurements—*this can only be done by radiography*.

A very rough-and-ready method is to pass two fingers high into the vagina—if the promontory and lateral margins of pelvic brim can only be reached with great difficulty there is probably no deformity of consequence, and *vice versa* if the promontory can be easily reached there is definite pelvic deformity.

The manual method generally employed in practice is to take the *oblique conjugate* by means of the fingers (Fig. 218), and from this measurement to calculate the *conjugata vera* (C.V.). To do this the middle and forefinger of the right hand are passed into the vagina until the middle finger impinges on the promontory and the forefinger is pressed against the subpubic ligament. The forefinger of the other hand marks off the lower margin of the subpubic ligament. Both hands are then withdrawn, and the distance between the tip of the

middle finger and point marked on the forefinger measured with a tape or calipers. In taking this measurement, it is hardly necessary to state that it should be done with the greatest care. It is most important that the finger is pressed against the true promontory, and not against a false one, and also that the lower margin of the subpubic ligament is marked off exactly.

Here again, however, is a difficulty, for the difference between the *oblique* and *true* conjugate is variable. We commonly reckon the true conjugate as between $\frac{1}{2}$ and $\frac{3}{4}$ inch (1.2 and 1.9 cm.) less than the oblique conjugate. But from measurements made post mortem on women whose pelves were examined during life we have found the error as great as 1 inch (2.5 cm.).

For practical purposes, in estimating the true conjugate from the oblique, one must consider: (1) The depth of the symphysis pubis. The deeper it is, the more must be allowed. (2) The angle of the pubic symphysis to the horizontal. The more obtuse it is, the more must be allowed. (3) *The height of the promontory. The higher it is, the more must be allowed. This is a very important point. The height of the promontory determines the degree of obliquity or "inclination" of the pelvic brim*, as has already been mentioned in connection with high assimilation pelvis (p. 512) and rachitic pelvis (p. 514). Obviously the greater the obliquity the more difficult is it for the head to engage.

In thin women who are not pregnant it is possible to measure the conjugata vera from the abdomen, for the posterior surface of the symphysis and the promontory of the sacrum can be quite readily felt through the abdominal wall.

But in contracted pelvis there is another very important factor influencing the parturition—viz., *the size of the fœtal head*. The fœtal head varies in size, but, what is perhaps of even greater importance, it varies in consistency and mouldability. A large or very ossified head will pass through a contracted pelvis less easily than a small or defectively ossified one. It is now possible to measure the fœtal head *in utero* by radiography, but not with the same exactness as the maternal pelvis (*vide* Chapter LX).

Pelvic and cephalic radiography are of the very greatest help in diagnosis. But in slight maladjustments of head to pelvic brim they fail, and will always fail, to supply exact information regarding: (a) Consistency and mouldability of head; (b) the strength of the uterine contractions; (c) adjustments of head to pelvis resulting therefrom. The effect of these most important factors can only be gauged after labour has been in progress for some time—this explains and justifies the employment of "*trial labour*" in "*borderline*" cases.

We must now direct attention to the very important clinical examination of *estimating the size of the fœtal head relative to the*

maternal pelvis by manual means. In this connection we would remind our readers of the arresting aphorism by Barbour, "The foetal head is the best pelvimeter."

There is here represented (Fig. 219) Munro Kerr's method now generally employed. The external hand pushes the head into the pelvis, while the fingers of the other hand estimate the relative size of pelvis and head. It may be employed without anæsthesia ; but greater accuracy is obtained if the woman is anæsthetised. The patient is placed in the ordinary position for a gynecological examination, and

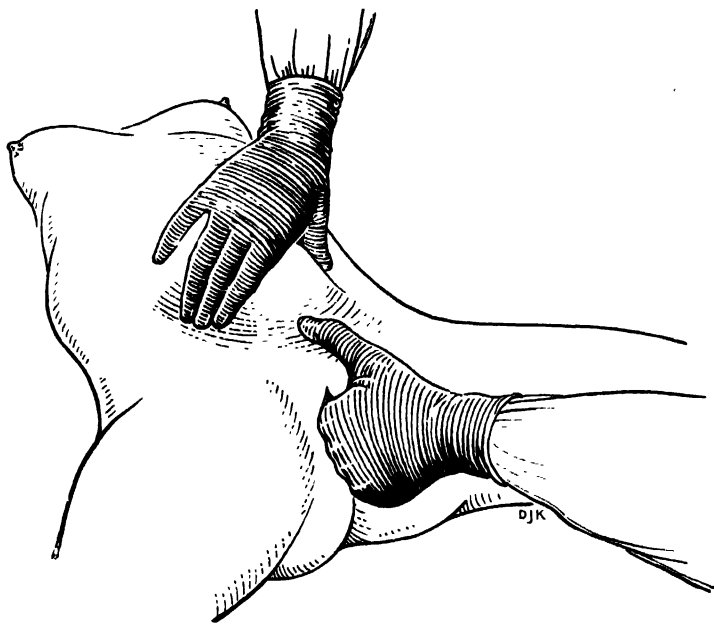


FIG. 219.—Method for estimating Relative Size of Foetal Head and Maternal Pelvis. It is sometimes of advantage to place the patient in the lithotomy position (modified). This method is an improvement on Muller's method in that the thumb of the hand (here left hand) whose fingers have been passed into the vagina estimates the degree of overlap of foetal head.

the accoucheur stands at her side, facing her. The right hand grasps the head, and presses it into the pelvic brim. Two fingers of the left hand are passed into the vagina. These determine the consistency and manner of engagement of the head. Further information is obtained by utilising the thumb, which is passed along the brim, and estimates the degree of overlapping. By this method the relative size of the foetal head and maternal pelvis can be determined and a prediction made as to whether the head : (a) will pass spontaneously ; or (b) will not pass—in which case Cæsarean section is necessary. It is not claimed that this prognostication can be made at the thirty-sixth week of pregnancy with anything like the accuracy possible after labour has been in progress for some little time. In the interval changes occur in the soft parts, in the pelvic joints, in the attitude of the

head, and in the moulding of the head, which may put an entirely different complexion on the question—will the head pass ?

One point has to be particularly noted—viz., the variety of parietal obliquity or asynclitism (p. 515) which exists or is produced by the external hand when examining. Often one can make the head engage in either of these positions. Thus, if an anterior obliquity (posterior parietal presentation) is produced, there is a great degree of overlap ; while if a posterior obliquity (anterior parietal presentation) is produced, there is very little overlap. Thus the actual state of matters may be made to appear worse or better than is actually the case. At the thirty-sixth week of pregnancy it is uncertain which biparietal obliquity will develop when labour comes on ; this, as everyone admits, makes the greatest difference between an easy or difficult (often impossible) passage of the head through the brim.

To sum up, then, the manner in which one should approach a case of contracted pelvis at the thirty-fifth week is as follows. Note should be taken of : (1) The general appearance of the patient and the obstetric history, if she is a multigravida. (2) The external and internal pelvic capacity as measured manually and by radiography. (3) Size of the foetal head relative to the maternal pelvis.

The examination just described is obviously only possible if the head is the presenting part. *Should the presenting part be the breech*, external version may be performed and the head brought over the pelvic brim for the purpose of making the examination. But we do not favour such a procedure even in a slight degree of pelvic malformation—*firstly*, because version in the circumstances may be difficult to carry out ; *secondly*, because the foetus frequently returns to its former presentation. Therefore, if there is any pelvic malformation, we advocate the employment of Cæsarean section, because a breech delivery through a malformed pelvis, even when the abnormality is slight, is difficult and is associated with a high foetal mortality and morbidity.

Treatment.—It is most desirable that all patients in whom any pelvic malformation has been recognised at the antenatal examination in the thirty-sixth week of pregnancy (p. 191) should be transferred to an institution when labour is impending, or prior to that time if induction of labour is contemplated. The patient's home is not a suitable place for the confinement, as there are not the facilities for operative interference should the necessity arise. Even if labour has commenced this should be done, unless circumstances are such that transportation is impossible, or the condition of the patient is so critical, owing to some co-existing complication, that her removal is contraindicated.

The treatment of pelvic disproportion has been much simplified in recent years. Two procedures of former times have been discarded.

The first to go was *version and traction on the legs*—the routine procedure prior to the introduction of axis traction forceps in the late seventies of last century (p. 700). The next to be discarded was the *high forceps operation*. It was found that to drag the head through a contracted pelvis with forceps, by employing extreme force, was dangerous to both mother and child. We admit that the obstetrician of great experience who appreciates the limitations of the “high forceps” operation may employ it safely and with success in carefully selected cases; but the general employment of the operation is so dangerous that we do not deem it advisable to describe it in this textbook, written primarily for undergraduates.

In recent years the procedures have been limited to :—

1. Induction of labour.
2. Trial of labour.
3. Cæsarean section.
4. Craniotomy.

1. INDUCTION OF LABOUR.—In every country except Great Britain this operation is looked upon with disfavour. Gradually, obstetricians in this country also are coming to the same conclusion in respect to *primigravida*, because they have found that the early and later foetal mortality is very high (8 to 12 per cent.). In respect to *multigravida* matters are quite different—in carefully selected cases the operation may be most suitable, indeed it may be the ideal procedure. The reasons, of course, are obvious—the records of the progress of events in former labours are available, and, furthermore, the soft parts (cervix and vagina) are not so rigid and resistant. Details regarding the operation are given elsewhere (p. 734).

2. TRIAL LABOUR AND SPONTANEOUS DELIVERY.—As labour approaches it may be possible to determine, with a little more exactness than can be done at the thirty-sixth week (p. 191), the relative disproportion of head and pelvis, and to say (*a*) that the disproportion being so slight the head will certainly pass through the pelvic brim and cavity, provided the forces are normal; or (*b*) that the disproportion being so pronounced the head cannot possibly pass, no matter how strong the forces may be.

Between these two extremes, however, come a large number of cases in which there is uncertainty—they are sometimes termed “borderline” cases in this connection. For such cases the majority of obstetricians who have had an extensive experience of pelvic disproportion and its treatment recommend “a trial of labour,” or, to put it more briefly, “trial labour.” It has been already indicated that as labour develops there occurs a slight “give” in the pelvis (p. 121), and moulding and adjustment of head to the pelvis quite impossible to predict with exactness. Furthermore, there is no means of telling beforehand what the character and strength of the expulsive

forces may be. For these reasons we advocate "trial labour," and we claim that, if this method of treatment is *judiciously employed*, it gives outstandingly good results in respect to both mother and child. *If the figures of large maternity hospitals, in which this treatment is wisely employed, are examined it will be found that spontaneous delivery (with possibly a little assistance with forceps at the outlet) is attended with an extremely low maternal and foetal death-rate.* There are records of series of many hundreds of cases in which there was no maternal death, and a foetal death-rate of not more than 2 to 3 per cent., if disease, malformation and marked prematurity of foetus are excluded, as they should be, when assessing the dangers of this particular treatment.

Some critics of the procedure maintain that "the trial labour" is a confession of failure on the part of the accoucheur to make an exact diagnosis, while others object to it because of the danger to the child. The former obviously fail to appreciate the finer points in treatment; the latter have been answered in the preceding paragraph. We do, however, admit to the latter that, if trial labour is employed beyond rational limitations, the child may suffer; but every treatment has its limitations. The first and most important lesson the practising obstetrician has to learn is to appreciate the advantages, the disadvantages and the limitations of each and every operative procedure.

To return to "the trial labour"—what, we ask, is the alternative? We have already indicated the objections to induction of labour in primigravidae; consequently the only alternative is Cæsarean section. If this course is followed, 80 to 90 per cent of Cæsarean sections will be performed unnecessarily in "borderline" cases.

Having said so much in favour of "the trial labour," we would point out that it is employed on the understanding that at any time in the course of the labour interference by Cæsarean section may be necessary. The writer's experience is that Cæsarean section has been necessary in 6 to 10 per cent. of the selected borderline cases allowed to go into labour with the expectation that spontaneous delivery would occur, or an easy delivery with forceps at the outlet would be sufficient. *Obviously, therefore, with this possibility of Cæsarean section ever present the management of "the trial labour," more especially in respect to the employment of sedatives and vaginal examinations, must receive special consideration.*

The Conduct of "Trial Labour."—It is advisable to hold one's hands as regards the giving of sedatives—more freedom is permissible when it becomes certain that the head is adjusting itself to the pelvis and passing downwards.

It is customary to make a vaginal examination early in labour for the purpose of excluding prolapse of cord, which is liable to occur in the circumstances. If the cord is found presenting, or prolapsed (p. 499),

and good pulsations in it can be detected, Cæsarean section should be performed. We advise that the examination should be made under "gas and oxygen anæsthesia," because precautions against infection can be better carried out, and a more exact estimate of the relative size of head and pelvis made. Some obstetricians, however, in their desire to dispense with a vaginal examination early in labour, are prepared to risk the accident of prolapse of the cord—over a long series of cases this omission might affect adversely the foetal mortality by about 1 per cent., but not by more.

The size, consistency, position and, if possible, the direction of the sagittal suture should be noted. If the sagittal suture is occupying the middle line of the pelvis or is directed towards the sacrum (anterior parietal presentation, p. 515), and certainly if the head, grasped by the external hand, can be made "to bite" into the pelvic brim, there is every prospect that the head will pass into the cavity. If, on the other hand, the overlap is more pronounced and the sagittal suture runs nearer the symphysis (posterior parietal presentation, p. 515), the prospect of descent of the head is definitely less likely. Consequently in the latter event the overlap must be carefully noted by external palpation every half hour or so. If it becomes more pronounced, even indeed if it persists, the writer advocates abandonment of a further trial of labour and recourse to Cæsarean section (*vide* footnote, p. 515).

If a complete examination as described has been made early, the labour can be followed by palpation and auscultation as described for a normal labour (p. 404). The head, if it is going to pass, becomes more fixed and the overlap disappears. In the case of the flat rachitic pelvis, descent of head into pelvic cavity may occur quite suddenly during a pain.

In many instances a second vaginal examination is unnecessary; but if doubt exists as to the progress of the labour the patient should be prepared for Cæsarean section, anæsthetised with gas and oxygen, and a final decision made as to whether labour should be permitted to continue further or Cæsarean section performed.

It is obvious that, once labour is well established, Cæsarean section may be indicated if the forces are poor in quality and strength. For a successful result from "trial labour" strong uterine contractions are essential. Under no circumstances, however, is it permissible to give oxytocics. Should the pains, on the other hand, become extremely strong and anæsthesia does not control their violence, Cæsarean section may be deemed advisable if in spite of their strength there is no obvious progress—viz., descent of head.

Again it is obvious that, once the foetal head has passed the obstruction and is well down in the pelvic cavity, there is no objection to employing forceps if the forces are threatening to weaken. In point of fact, forceps extraction is indicated in the circumstances.

This judicious employment of forceps at the outlet is very different to the older and most dangerous procedure of dragging the head past the obstruction at the brim by means of forceps.

In the preceding remarks on the conduct of "the trial labour" no reference has been made to the position of the patient or "postural treatment." With the object of increasing the conjugate diameter of the brim (C.V.) the so-called "Walcher position" (Fig. 220) was advocated by many writers and used extensively when forceps was employed to pull the head past an obstruction at the brim—a procedure which, as already stated, has been discarded. Some authorities of to-day suggest that the position may be adopted with advantage by the patient who is undergoing a "trial labour." We would point out, however, that the Walcher position, while undoubtedly it increases slightly the conjugate vera, also increases the obliquity of the pelvic brim, and this may more than outweigh the advantage of the slight pelvic increase. Besides, the position is uncomfortable and disturbing to the patient. A modified "Walcher position" with the patient's feet resting on a stool nullifies almost entirely any gain—it is the weight of the hanging legs acting on and depressing the ossa innominata that brings about the slight increase in the conjugate diameter of the brim.

Matters are entirely different in respect to the "squatting position," the primitive and ideal position when the head has reached the pelvic outlet (p. 378). *The position, however, is impossible for the patient who receives anaesthetics or sedatives.*

Our readers will realise that the conduct of a "trial labour" calls for great judgment and this can only be acquired by patient observation of many examples of obstructed labour. Obstetricians who are not prepared to undergo this training can never gain experience in the conduct of an obstructed labour due to pelvic disproportion—they will continue to perform unnecessary Cæsarean sections, smug and self-satisfied in their ignorance of the finer points of obstetric practice.

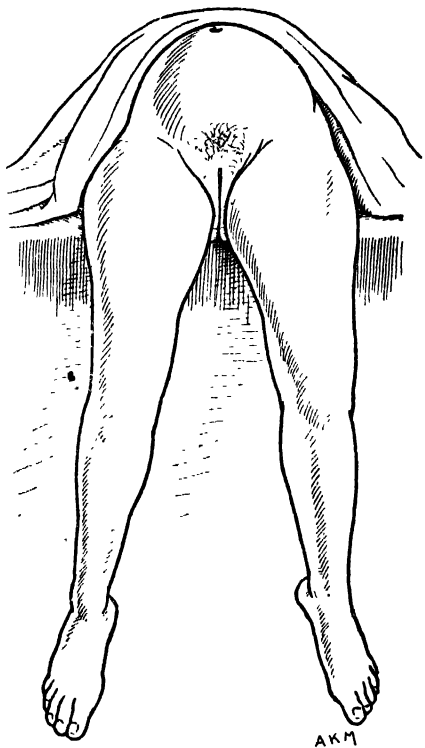


FIG. 220.—Walcher or "Hanging Leg" Position.

3. CÆSAREAN SECTION.—Cæsarean section in respect to contracted pelvis is indicated—(a) where a live child cannot be born, or the dangers are too great to permit it being born, *per vias naturales*; (b) in the case of a dead child where the risks from craniotomy are greater than those from Cæsarean section.

In minor degrees of pelvic deformity the pelvic radiograph should be examined, a careful estimate of the relative size of the head and the pelvis made, and the operator should then choose Cæsarean section (p. 717) or the trial of labour, as already described.

Turning to the other group in which the pelvis is extremely deformed, and Cæsarean section must be employed whether the child is alive or not, $2\frac{1}{2}$ inches (6.2 cm.) may be considered the figure of compulsory Cæsarean section. No doubt it is possible to do a craniotomy even with a pelvis of $2\frac{1}{2}$ inches or slightly under that figure, but in the circumstances it is an operation of extreme difficulty and attended with very great danger to the mother.

4. CRANIOTOMY.—Theoretically, craniotomy should only be performed if the child is dead; but, as the results from Cæsarean section where the operation is performed after unsuccessful attempts at delivery with *forceps* show a high maternal mortality rate, it is unwise to subject these women to Cæsarean section. Besides, the fœtal death-rate is very high in such cases. Consequently if the child is moribund it is generally the right procedure to perforate a living child. But let it be understood that craniotomy would almost never be necessary if the patient were transferred to hospital before labour or even early in labour. The subject will be referred to again in connection with the operations of Cæsarean section and craniotomy.

(b) OBSTRUCTION MORE PARTICULARLY AFFECTING THE PELVIC OUTLET

Diagnosis.—Radiography of pelvic outlet (Chapter LX) is a little more complicated than radiography of inlet. Even by the stereoscopic method there are details of outlet formation which do not show up. Therefore it is simpler and just as good to rely on the exact measurement, which can be made by calipers and the hands, as here shown. The *transverse diameter of the pelvic outlet*—the distance between the tuberosities of the ischium—can be measured with exactness by calipers (Fig. 221) and approximately by the hands (Fig. 222). Deformities affecting this diameter are found in “funnel-shaped,” kyphotic, and anthropoid (p. 536) pelvis. In all these varieties of deformity difficulty is experienced in the delivery whenever the measurement falls below $3\frac{1}{2}$ inches (8.7 cm.); and even at $3\frac{1}{2}$ inches, if the head is large and the presentation an occipito-posterior one, the delivery may be very difficult.

Conjugate or Antero-Posterior Diameter.—It occasionally happens

that this diameter is diminished (a) in flat rachitic pelvis where the coccyx is tilted forwards; (b) as a result of a fracture of the coccyx at a previous labour; (c) in flat non-rachitic pelvis; (d) in the

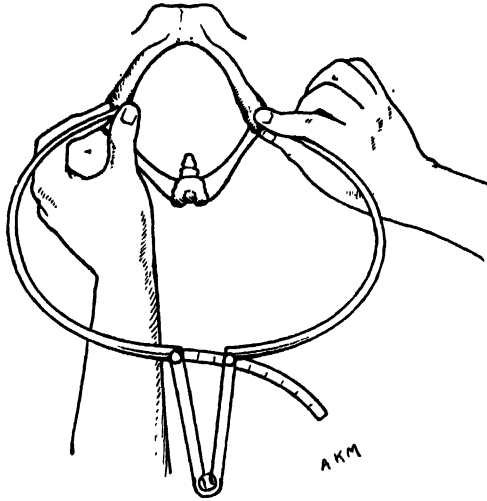


FIG. 221.—Measuring Transverse Diameter of Outlet.

android type (p. 536). The first is not of serious consequence because the capacity at the outlet is increased transversely. The second may cause considerable obstruction unless the rational treatment of removal

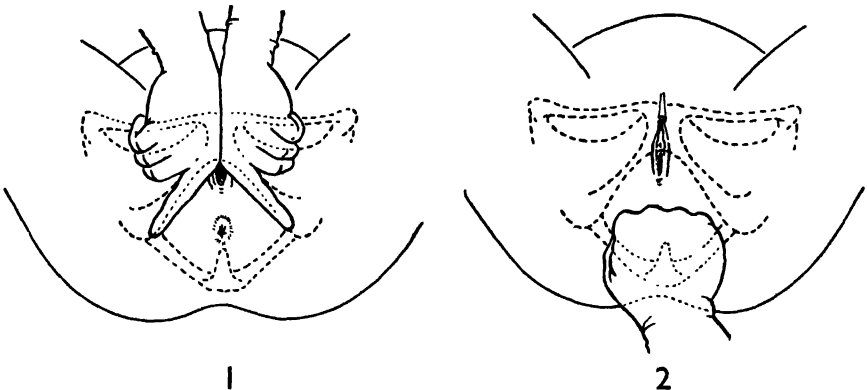


FIG. 222.—Estimating Capacity of Pelvic Outlet by means of Closed Hand.
1. Subpubic angle. 2. Distance between tuberosities of ischium.

of the coccyx is employed. A common procedur  is to drag the head out by means of forceps, with the result that the coccyx may be refractured, the mother otherwise injured, and the child sustain intracranial injury.

The most troublesome cases, however, of antero-posterior deformity occur in (c) *flat non-rachitic pelvis* (p. 510), in which there is a flattening

and obliteration of the sacral curve; and (d) the android type of pelvis (Fig. 223). These malformations cause the worst examples of "deep transverse arrest" of the head (*vide* p. 448).

Treatment.—Delivery in cases of outlet deformity may be very tricky. In such cases the accoucheur is often not alive to the difficulty until labour is far advanced or even until he has applied forceps and failed to affect delivery—it seems so simple to deliver a child whose head can be seen if you retract the vaginal walls. Consequently we do stress the importance of a careful examination of the pelvic outlet in every case.

Forceps.—If forceps is employed in this condition the delivery can only be accomplished by extreme traction, and should the transverse or antero-posterior diameter be under $3\frac{1}{2}$ inches (8·7 cm.) it may be impossible. Even by making deep incisions into the perineal body or to the side (episiotomy) the delivery may not be made much easier.

Symphysiotomy.—*If there is any condition in which one can say that symphysiotomy is indicated, it is deformity of the pelvic outlet.* As a result of this operation every inch of separation between the pubic bones gives very nearly an equal separation between the tuberosities of the ischium, the very diameter one wishes increased; besides, with the head so low, the delivery with forceps after symphysiotomy and episiotomy is easy. The writer considers symphysiotomy a most suitable operation for carefully selected cases of outlet deformity; but very few obstetricians in this country are in agreement with him (p. 715).

Cæsarean Section.—Should symphysiotomy be looked upon with disfavour, Cæsarean section is the only alternative if the child is to be delivered alive. If, however, many examinations and/or attempts to deliver with forceps have been made, the risks from Cæsarean section in respect to infection are considerable.

Craniotomy.—Craniotomy should be employed in cases in which the child is dead or dying (p. 532).

B. MINOR VARIATIONS IN PELVIC FORMATION AND THEIR INFLUENCE ON LABOUR

The majority of those interested in the practice of obstetrics still visualise pelvic disproportion as implying a less or more pronounced deformity, relatively easily recognisable, and for which the treatment is fairly obvious. Those grosser malformations have been described. Now we must consider briefly the slighter variations in pelvic formation which, in the light of recent investigations by means of X-rays, would appear to play an important rôle in the production of malattitudes and malpositions of the foetus, and may thus directly influence prejudicially the passage of the child through the birth canal.

More than half a century ago one of this country's greatest anatomists, Sir William Turner, wrote, "With the exception of the skull no part of the skeleton presents greater individual variations than the pelvis." Turner made his investigations of pelvic variations on dry pelvises in anatomical museums—radiologists can now demonstrate them on the living subject. It is of interest that the classification proposed by Turner is, with slight modifications, that adopted by the modern writers to whom reference is made later.

For generations obstetricians surmised and hinted that minor pelvic disproportion was an influencing factor in the production of such departures from the normal as occipito-posterior position of head, deep transverse arrest of head, face, brow and breech presentations, and prolapse of the cord. It was impossible, however, to determine the exact nature of the minor variations responsible for the complications mentioned because the only means available were the hands and pelvimeters, which were not sufficient for the purpose. To-day, however, exactness is possible by means of radiography. By *antepartum* radiography pelvic formation and size, shape, attitude and position of head can be determined; and by *intrapartum* radiography adjustments (favourable or unfavourable) in position and attitude of the head occurring during labour can be observed.

We repeat here the words of warning expressed earlier in this chapter. It is the height of folly to imagine that by means of antenatal radiographic pelvimetry and cephalometry the most suitable treatment can in all cases be determined before labour. *As already pointed out, there occur in the days and hours immediately preceding labour changes in the lower pole of the uterus in pelvic joints and the soft parts; and, early in labour, adjustments and moulding of the head to the pelvis, the degree and character of which is impossible to predict with exactness. We would stress also that the strength and efficacy of the forces is impossible to gauge beforehand.*

When dealing with fractions of a centimeter in respect to adjustment of head and pelvis it is obvious that even with the most perfect radiograph of maternal pelvis and foetal head before your eyes you must go cautiously in basing treatment on the radiographic picture alone.

Although we sound this warning note, we align ourselves with those who claim that antepartum and intrapartum radiography may furnish most valuable information in respect of the conduct of the labour.

Our country is very often a late starter, and in the matter of pelvic radiography this is especially the case, largely because so few of our maternity hospitals had been equipped, until recently, with an X-ray installation. Indeed, in this country we are indebted almost entirely to radiological specialists, such as Rowden, Reece, Roberts, for directing attention to this field of obstetric investigation. To-day

in this country, as in the United States of America, practising obstetricians have also come to take a part, which is obviously essential. *The radiological specialist presents the picture, but it requires the experienced practical obstetrician to interpret aright the significance of the particular radiograph.*

In common with other obstetricians we express our gratitude to a group of American obstetricians, including Thoms, Caldwell

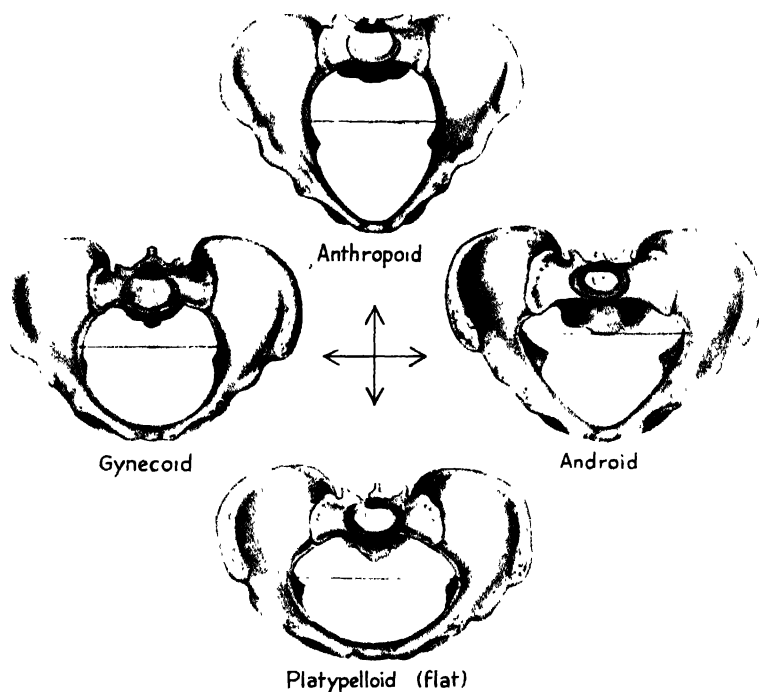


FIG. 223.—Characteristic Inlet of the Four Parent Types of Pelvis (Caldwell and Moloy).

and Moloy, who in recent years have been directing attention to the slighter pelvic variations which radiography has revealed. In Fig. 223 are illustrated the four main types Caldwell and Moloy describe.

They are (a) gynecoid, (b) androïd, (c) anthropoid, (d) platypelloid. Thoms' classification is different: (a) Dolichopellic (anthropoid); (b) mesatipellic (round); (c) brachypellic (oval); (d) platypellic (flat). This is in conformity with Turner's classification.

All recognise and describe intermediate variations in which the pelvic formation shows a combination of two or more parent types; but we cannot follow them into these refinements. Race is a very important factor, more especially in the United States of America where there is such a large black population.

The figures below are those presented by Thoms¹ (1939) for 600 white women :

	Per Cent.
Dolichopellic (anthropoid)	15.3
Mesatipellic (round)	43.3
Brachypellic (oval)	35.0
Platypellic (flat)	4.3

The "round" and "oval" types conform less or more to those included in the *gynecoid* type of pelvis ; and Thoms' figures show that they make up 80 per cent. of all the cases. Thoms does not include the "android" type of pelvis in the above classification as he maintains that android characteristics may be added to one of the other types at any part of the pelvis. He claims that only on rare occasions is a pelvis truly *android* from brim to outlet. More common is it to get a slight android deformity affecting the lower part of the pelvis.

So far no definite figures for this country have been presented, probably they will not be uniform for all localities.

With regard to the progress of labour of occipito-posterior positions in these different types, the results according to Moloy appear to be as follows :—

1. The *gynecoid* type of pelvis need cause no concern.

2. With the *anthropoid* type the occiput generally rotates backwards, but owing to the capacity of the posterior section of the pelvis, spontaneous delivery "face to pubes" is frequent.

3. With the *android* type a persistent occipito-posterior presentation is frequent ; but spontaneous delivery "face to pubes" is infrequent. Lastly, "deep transverse arrest" often occurs—indeed it is this type of pelvis which accounts for most of the cases of "deep transverse arrest." The true *android* pelvis, as Thoms indicates, is not encountered very often. It is the most serious variety and may be associated with great dystocia.

If these findings are confirmed by other observers, it is obvious that a radiograph may assist one to determine the most suitable procedure to employ in an occipito-posterior position. Should the radiograph show a *gynecoid* type of pelvis, no interference, at least early in the second stage, is necessary, as spontaneous rotation of occiput forwards generally occurs. If, however, the picture is that of an *anthropoid* type it is generally better not to interfere early, although there is the probability that the birth will have to be "face to pubes." In the circumstances the birth is very often spontaneous, and if not, extraction with forceps is not difficult. Lastly, if the picture is more of an *android* type, manual rotation early in the second stage should be considered and Cæsarean section if the deformity is extreme.

Recent investigations by Nicholson² (series of 350 cases in rural

¹ Thoms, *Amer. Jour. Obst. and Gyn.*, January 1939.

² *Journ. Obst. and Gyn., Brit. Emp.* (1939), vol. xlv, 950.

Gloucestershire) and by Ince and Young¹ (series of 500 cases in London) do not appear to agree with the findings of Thomas and Caldwell and Moloy. Possibly the latter have overelaborated the classification of minor pelvic variations and stress their importance unduly. It must be borne in mind, however, that they have been indefatigable workers in this special field for very many years and employ instruments of great precision.

GENERAL SUMMARY

As so often happens when any new method of examination or of treatment is proved and accepted—radiological pelvimetry comes into the former category—there is the tendency to push it beyond its legitimate limits and to expect too much from it.

In respect to pelvic radiography this can definitely be stated :—

1. The experienced radiologist can present an exact picture of the pelvis and exact measurements of the pelvis at all levels from cavity to outlet.

2. When the radiograph conforms to the normal standard the possibility of pelvic disproportion as a cause of dystocia is removed—this especially in a primigravida is of inestimable value in practice as a guide to the management of labour.

3. When the radiograph shows marked pelvic malformation, Cæsarean section is almost certainly indicated.

4. When the radiograph shows minor deviations from the normal the procedure to be followed when labour eventuates can be quietly considered beforehand. It is on this group that obstetricians are concentrating attention at the present time. Extended and most careful investigations of the course of labour in long series of such cases must be carried out before treatment can be standardised—if, indeed, it can ever be absolutely standardised. At present there is no approach to general agreement—there are those who recommend the “trial of labour” and those who condemn it. There are those who advocate “induction of labour” and those who are opposed to it. And lastly, there are those, with little experience and interest in obstetrics, who advocate the easy course and perform Cæsarean section freely. We have already pointed out how undesirable is the practice of induction of labour in a primigravida (p. 528). The most rational, as it is the most scientific, procedure is to give labour a trial, noting most carefully the foetal heart sounds, the character of the pains, and the degree to which the head shows signs of moulding through the pelvis.

¹ *Journ. Obst. and Gyn., Brit. Emp.* (1940), vol. xlvii, 130.

CHAPTER XXXI

DYSTOCIA DUE TO FAULTS IN THE PASSAGE (*continued*)

Obstruction in the Utero-vaginal Canal—Obstruction from Organs and Tissues in or around the Utero-vaginal Canal

A. OBSTRUCTIONS IN THE UTERO-VAGINAL CANAL

HAVING considered in the previous chapter obstructions in the bony canal which may cause difficulty in labour, we are now in a position to discuss obstructions in the soft parts. The points in the canal where obstructions occur are from below upwards: (1) perineum and vaginal outlet; (2) vaginal canal; (3) external os; (4) internal os; (5) retraction ring; and (6) alterations in axis of the parturient canal; (7) malformations of uterus and vagina.

(1) **Perineum and Vaginal Orifice.**—The commonest obstruction at this point is rigidity of the perineum. In some cases this is due to an abnormal development of the muscles of the pelvic floor; in others the cause is an inherent rigidity of the tissues of perineum and vaginal canal. Naturally, it is more commonly observed in primiparæ.

But in some instances the perineum is at fault in another way. It is so soft and sags to such an extent when pressed upon by the head that the forward movement of the head round the symphysis does not occur. This explains the unusual form of "central" perineal laceration (p. 596).

Obstruction at the vaginal orifice is generally of the nature described, but in some cases it may result from cicatrisation following injuries at a previous parturition, or infections associated with vulvo-vaginitis. Occasionally, also, a small cystic or solid tumour may obstruct the vaginal outlet.

Treatment.—If the obstruction is due to simple rigidity of the part it is better to incise the posterior or postero-lateral wall of the canal (*episiotomy*) (Fig. 224) rather than drag the child through by force, with resulting extensive laceration. After delivery, the incision should be carefully stitched.

With many of the cases of slight rigidity of the perineum and vulvar orifice, the parts undergo considerable relaxation under anæsthesia. It may sometimes be found of advantage to insert the gloved hand into the vagina, and stretch the canal prior to extracting the child

with forceps. This "ironing" of the perineum, as it has been termed, must only be performed under anæsthesia and after the most careful disinfection of vulva and vagina. We are not prepared to advocate its free employment, but we admit that in certain cases, if carried out by an experienced obstetrician, the delivery of the child is facilitated and laceration of the perineum prevented. It is therefore the alternative to episiotomy in primiparæ.

Where the obstruction is due to cicatrisation, episiotomy is the better choice. But if the cicatrisation is extreme—the result, for example, of a repair of an extensive and complete vaginal and perineal laceration at a previous labour—Cæsarean section may even have to

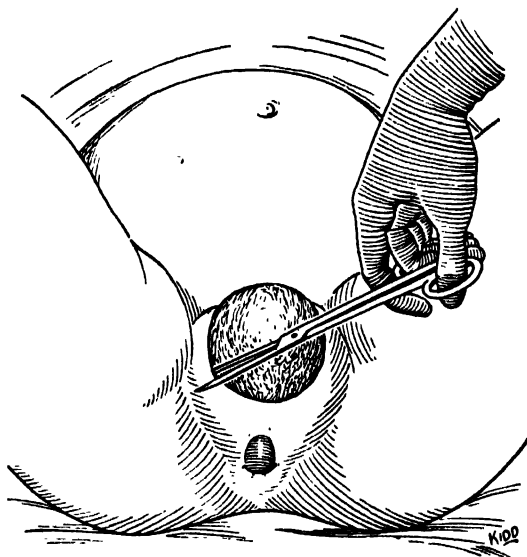


FIG. 224.—Episiotomy.

be considered. If any tumour interferes with the exit of the child it should be removed prior to the delivery.

(2) **Vaginal Obstruction.**—Apart from congenital narrowness of the canal, most examples of vaginal obstruction result from cicatrisation. These cicatrices are generally due to severe injuries at a previous parturition, although occasionally they are the result of an accident, or have followed a severe vaginitis (specific fevers, syphilis, or gonorrhœa). Another but less frequent cause is a tumour of the vaginal walls (p. 298). Very occasionally, also, tumours of the rectum, bladder, etc., are responsible for the obstruction; these abnormal conditions are considered later in this chapter.

Lastly, one condition of great rarity must be referred to—viz., a *vaginal diaphragm*, most commonly situated at the junction of the middle and upper third. It results from imperfect canalisation of the vagina, and is therefore a developmental error (p. 94). This diaphragm

may be almost complete, only a small opening being present in the centre. Cases indeed have been reported in which the opening became closed during pregnancy, as occasionally happens to the os externum uteri (p. 543). Obviously these two abnormalities may be difficult to differentiate. In such an event a recto-vaginal examination may clear up the diagnosis.

Treatment.—The treatment of the various conditions mentioned is self-evident in most instances. Tumours should be removed, an obstructing diaphragm incised both laterally and antero-posteriorly. The only two conditions in which it may be a little difficult to determine the best course to pursue is where there exists a congenital narrowness of the vagina or an acquired stenosis from inflammation, injury, etc. In such cases the operation of Cæsarean section should be considered; it is certainly the best course where these obstructions are pronounced. It should not be forgotten, however, that minor degrees of narrowness and rigidity often disappear as labour progresses and the tissues soften.

(3) **External Os.**—**RIGIDITY OF CERVIX.**—The commonest cause of cervical obstruction is generally referred to under the term “rigidity of the cervix,” and the ordinary classification is:—

- | | | | |
|------------|---|---------------|---|
| 1. Organic | { (a) Inflammatory.
(b) New Growths. | 2. Functional | { (a) Spasmodic (trismus uteri).
(b) Constitutional. |
|------------|---|---------------|---|

Organic Rigidity.—This may be inflammatory or result from new growths. The inflammatory form is where the cervix is hypertrophied and enlarged as a result of chronic inflammation. The condition is fully described in the gynæcological section (p. 906). Even the most hypertrophied cervixes generally soften and permit the easy passage of the child. Sometimes the lips of the cervix have to be pushed past the presenting part. Only very occasionally indeed is amputation of the hypertrophied lips necessary. The great danger is infection of uterus following labour—in many instances the hypertrophied cervix is deeply infected and calls for very thorough disinfection.

A very troublesome obstruction is occasionally encountered following amputation of cervix for pronounced hypertrophy and prolapse—Cæsarean section may be necessary (p. 719).

New Growths.—The two commonest new growths which may obstruct delivery are carcinoma and fibromyoma. The latter tumour is considered later in the chapter (p. 549).

Carcinoma of the cervix as a complication of pregnancy has been already referred to (p. 296). When discovered at the onset of labour the treatment will depend on the extent to which the disease has advanced. *If the condition is operable*, and we have already indicated how this may be determined (p. 296), the procedure favoured by some is to perform Cæsarean section, followed by total hysterectomy

condition the cervical canal is taken up but the os externum remains closed. It arises from the mucous membrane becoming agglutinated as a result of slight inflammation during pregnancy. On exposing the cervix by speculum, or by retracting the vaginal walls, a small dimple can generally be observed at the position of the os; but occasionally there is no trace of this dimple, the whole vaginal surface of cervix being uniformly smooth. On occasions the thinned-out cervix is pushed far down into the vagina by the presenting head.

The chief points in connection with the diagnosis of this condition are: (a) the danger of mistaking the thinned-out cervix for the unruptured bag of membranes; and (b) imagining that the cervix is fully dilated. As regards the first mistake, the consequences are not serious, for the accoucheur, even if he passes a pointed instrument, such as scissors or probe, through the thinned-out cervix, does no great injury. On the other hand, the second mistake is much more serious, for if an attempt is made to apply forceps over the head the vault of the vagina will be torn. It may seem to the novice incredible that such a grave mistake should be possible, but as a matter of fact it has been made on several occasions. The reason why the mistake is made is because the tissue is so thin that the "landmarks" of the presenting part can be easily felt through it. In reality the condition can be recognised if the accoucheur passes his finger beyond the presenting part, for there he will feel the vaginal vault instead of the lips of the fully dilated cervix; although the writer can remember one case in which the vault of vagina could not be reached by finger.

The treatment consists in making a crucial incision over the thinned-out cervix. When this incision is made the cervix dilates rapidly. It is better to leave the labour to proceed and allow the head to descend—manual dilatation is almost never necessary.

In a number of cases the uterine contractions are sufficient to overcome the obstruction and carry away a portion of thinned-out cervical wall, as already described (p. 543).

(4) **Internal Os.**—Passing to a higher level of the parturient canal it may be found very occasionally that constriction of the internal os interferes with descent of the presenting head or extraction of the after-coming head in a breech presentation. It is claimed that in some instances the constriction is due not to contraction of the internal os itself, but is produced by contraction or spasm of the paracervical tissue—we have grave doubts of this possibility.

(5) **"Retraction" and "Contraction" Rings.**—The "retraction ring" marks the lowermost limit of the active contractile portion of the uterus, the part primarily concerned in driving the child downwards. As labour progresses this section of the uterus retracts, but no proper constricting ring forms at the lowermost part of the area. Should, however, the labour be obstructed and prolonged, a thickened ring then forms termed the "Retraction Ring" or "Bandl's Ring"

— named after the German obstetrician of that name who, fully half a century ago, drew the special attention to it in connection with rupture of the uterus (p. 600). It may be raised sometimes up to nearly the level of the umbilicus and constitute a warning of impending rupture of the uterus. We are not, however, concerned at the moment with this ring, as it develops in the course of obstructed labour from pelvic disproportion, a shoulder presentation, etc., and followed sometimes by rupture of uterus. We are discussing the ring which may grasp more particularly the child's neck in the course of an ordinary labour and

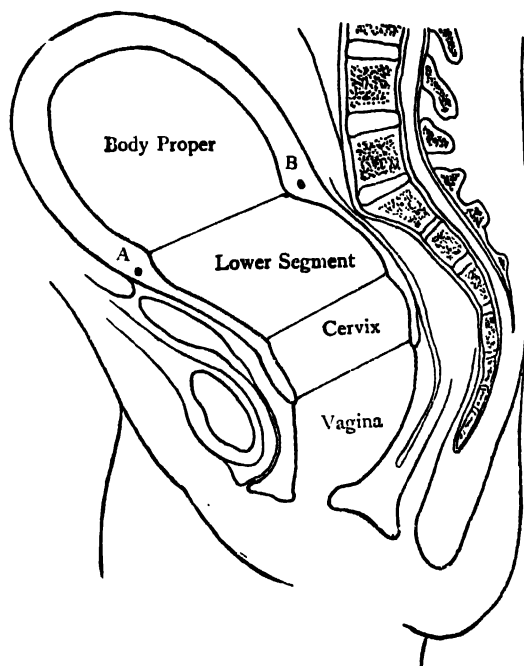


FIG. 225.—Diagrammatic Illustrations of Different Divisions of Parturient Canal. Compare this with Fig. 226 on next page. A and B mark the dividing line between retractile segment and lower uterine segments.

prevent descent of the child, or may hold up the placenta in the third stage of labour ("hour-glass contraction of uterus," p. 554). In the majority of cases of this nature the site of the stricture is the *Retraction Ring*, which as stated marks the lowermost limit of the active contractile portion of the uterus and the uppermost limit of the "lower uterine segment." Schroeder, unfortunately, confused the subject by naming the stricture a "*Contraction Ring*"—*in reality in most cases the condition is one of spasm in a potential "Retraction Ring."* Contraction rings or strictures may develop in other areas of the active contractile portion of the uterus, and at os internum

or os externum, as already described. Considering the thinness of the wall, and the quantity and distribution of the muscle fibres of the lower segment area formed from the isthmus of uterus (p. 21), we question if they can develop in the lower uterine segment itself (although some authorities maintain this is possible).

In the great majority of cases the patients are primiparæ, and an occipito-posterior position of the head is very frequent. It would appear, therefore, that this faulty position may be an important factor in producing the spasm we are considering. Pelvic disproportion of a readily recognisable degree does not appear to be an important

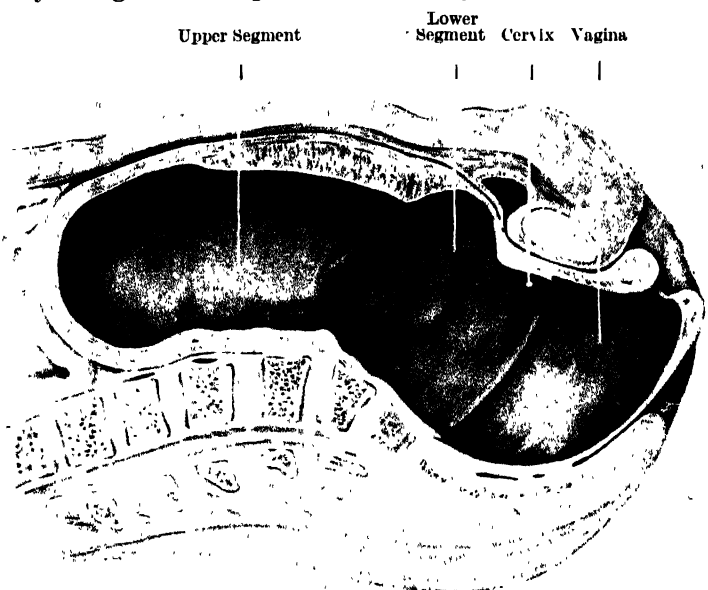


FIG. 226.—Frozen Section Late in Second Stage, shown with Fœtus removed. ("Anatomy of Labour," by Freeland Barbour.¹)

cause ; but in view of the high incidence of occipito-posterior positions and knowing as we now know from radiography that slight pelvic disproportion so commonly accounts for these faulty positions, pelvic disproportion may indirectly influence the occurrence of spasm.

Possibly, indeed probably, some form of irritant plays the most important part—mild infection and hormonal disturbance have both been suggested. Circular fibres in any fibro-muscular tube are always prone to spasm, and often from a very slight irritation. The point to remember is that the rest of the uterine body is not in tonic spasm,

¹ You hear to-day very little about "frozen sections" in obstetrics. In the end of last century and in the beginning of the present century much was written regarding these particular investigations, in which the trunks of women who unfortunately died during labour were frozen and sectioned. By this means the condition of the parturient canal and the position and attitude of the fœtus at different stages of labour were studied. Barbour's "Anatomy of Labour" (well illustrated) is a summary of these investigations, and in the opinion of the writer is an obstetric classic (J. M. M. K.).

but is contracting and relaxing in an ordinary manner. The reverse is the case in obstructive labour if rupture of uterus threatens.

The recognition of this condition is seldom made prior to experiencing difficulty in extracting the head, in making attempts to rotate the occiput forwards in occipito-posterior positions, or in extracting the after-coming head in breech deliveries. At this stage and in the event of the presentation being cranial, if the hand is passed through the cervix and beyond the head, the ring is generally encountered some 3 to 4 inches (7·5 to 10 cm.) above the os externum, the foetal head is free in the pelvis, and the uterine wall surrounding the head (the whole lower segment) may be lax during a uterine contraction—even the external os may not tighten up as it does in normal labour when a contraction occurs.

So far we have referred only to delay in the second stage from this cause, recognised by obstetricians of times past, including Smellie. In more recent years, however, a number of writers have pointed out that even during the first stage this complication of a constricting ring may develop and retard the progress of labour. They claim that it should be suspected (maternal pelvis and foetal head normal) if the head which should be descending is arrested, and if there is undue raising of the head in the intervals of the pains. Further, that the tightened ring may sometimes be felt by abdominal palpation. The authors of this work have witnessed very few cases of the latter nature and would lodge a protest against the too free employment of Cæsarean section in the circumstances.

Several drugs have been recommended for the relief of the spasm in the constricting ring. Those calling for special comment are morphia and atropine, spasmalgin, epinephrine, and amyl nitrite. Spasmalgin (Hoffmann La Roche), referred to earlier in this chapter (p. 542), is most suitable in cases of spasm or rigidity early in labour. Amyl nitrite (6 to 8 minims.) may prove most successful in the relief of spasm in the second stage of labour or if the placenta is held up by "hour-glass contraction" (p. 554). The effect of the drug, however, is very transitory, so that everything must be in readiness for extracting the child or placenta, as the case may be, before the amyl nitrite is administered. The patient must be deeply anæsthetised for the operation.

Drugs and anæsthesia, however, may be insufficient to bring about complete relaxation and to permit of delivery with forceps or by traction on the legs if the presentation is a breech. In head presentations, if conditions are favourable and the child is alive, Cæsarean section would be the natural choice. But in some instances, as labour has been protracted, the prospects of the child surviving are not good, more particularly if the cord is round the child's neck as is so often the case. Added to this, the risk of infection having occurred from repeated examinations and manipulations is so considerable that

Cæsarean section may not be justified. In such circumstances craniotomy may be the better choice. Where it is the "after-coming" head that has to be delivered the only procedure is obviously craniotomy (p. 748).

This particular condition as a cause of "hour-glass" contraction of uterus and retention of the placenta is dealt with elsewhere (p. 554).

(6) **Alterations in the Axis of the Parturient Canal.**—We have already discussed the various displacements of the uterus, and have seen that backward displacement more especially may gravely complicate pregnancy (p. 287). Here we would refer to the condition known as "pendulous abdomen," and the disturbances which result from vaginal and abdominal fixation of the uterus.

Pendulous Abdomen.—This condition has been already referred to (p. 287). It favours malposition of the child, breech presentation, and in a primigravida more especially, should arouse suspicion of pelvic disproportion. It interferes with the proper engagement of the head in the pelvic brim.

The treatment is simple. The uterus should be supported by a firm abdominal binder.

Result of Ventrofixation.—Ventrofixation for backward displacement and prolapse of the uterus described in Chapter LVI was at one time a favourite operation. Most gynecologists at the present time, if they ever employ the operation, reserve it for women who have reached the menopause as, in a number of instances where it has been performed early in reproductive life and pregnancy has followed, the delivery has been very difficult. The distortion of the uterus and alteration in the axis of the parturient canal which result may be so extreme as to necessitate Cæsarean section.

Still greater are the complications from "the interposition operation"; but this operation should never be performed until after the menopause (*vide* Chapter LVI).

(7) **Malformations of Uterus.**—Malformations of uterus, such as those described earlier (pp. 99-103), are rarely associated with pronounced dystocia. Undoubtedly, the uterus cordiformis (p. 476) favours the occurrence of oblique presentations, while uterus bicornis or subseptus almost necessitates an oblique lie. In the latter two conditions correction is generally impossible, so that Cæsarean section if the child is alive, or decapitation if it is dead, is the only procedure possible.

In the extreme varieties of duplication (uterus didelphys and pseudo-didelphys) the parturition is generally simple, because the child always takes up a longitudinal "lie." Difficulty may arise where the child has been driven through the vaginal septum between the two halves of the canal and its shoulders have been arrested by the partially torn septum. There have also been a number of cases recorded

where the non-gravid half has become displaced backwards and caused an obstruction.

An earlier reference to these malformations as they affect or are affected by pregnancy will be found in Chapter XIV, p. 292.

B. DYSTOCIA ASSOCIATED WITH THE ORGANS AND TISSUES IN OR AROUND THE UTERO-VAGINAL CANAL

The obstructions under this heading are, for the most part, tumours of uterine or ovarian origin which interfere with the descent of the child through the cervix. In addition there are occasionally encountered tumours of the recto-vaginal pouch, rectum, vagina, or vulva which may obstruct delivery. Details regarding these tumours will be found in the gynæcological section. As a complication of pregnancy, they are considered in Chapter XIV. Here we are primarily concerned with them in so far as they interfere with parturition.

The procedure in all these conditions is to remove the tumour, or, if this is not possible, to push it out of the way. Should neither of these alternatives be feasible Cæsarean section must be performed. *Under no circumstances should the child be dragged past the obstruction.* We would stress the advantage of recognising all tumours in pregnancy, for in most instances they can be removed without disturbing the pregnancy (pp. 294 and 299).

Fibromyoma of Uterus.—Fibromyomata are fully considered in Chapter XLVIII, p. 931. Tumours of this nature causing obstruction are those which project into the pelvis. For the most part those situated in the fundus cause very little trouble. As regards tumours merely overhanging the pelvic cavity it will be found that they are very often drawn up prior to or early in labour, owing to the development of the lower uterine segment (p. 368). If, however, they are far down in the pelvis, such a favourable occurrence cannot be expected.

There is rarely any difficulty in recognising tumours of this nature if of considerable size, as they cause irregular distortion of the uterus and often displace the cervix: but smaller tumours may be overlooked.

It occasionally happens that there is difficulty with the placenta, even although there may have been no great trouble with the birth of the child. Sometimes this occurs because the placenta is unduly adherent over the site of the uterine growth; in other cases it is retained because the uterine cavity is distorted.

Although postpartum hæmorrhage is stated as being a common occurrence with fibromyomata we have rarely witnessed this, and have found that it can generally be controlled by the ordinary means employed for dealing with this complication.

The treatment for fibromyomata which cause a distinct obstruction

to parturition is abdominal section, followed by extraction of the child by Cæsarean section. Having extracted the child by this means, the operator has then to decide whether he should remove the uterus or perform myomectomy and conserve it. It is not possible to enter into a discussion regarding the indications and relative merits of these two procedures, as the subject belongs to the province of advanced obstetrics and gynæcology (*vide* reference to question, p. 952).

Occasionally submucous fibromyomata are associated with excessive bleeding in the puerperium. In such cases hysterectomy is generally necessary, but in some, owing to the patency of the cervix, it may be possible to introduce the fingers, or even the hand, into the uterus and enucleate the tumour.

Ovarian Tumours.—These for the most part are cystomata. Here again difficulties arise only if the tumour occupies the pelvic cavity.

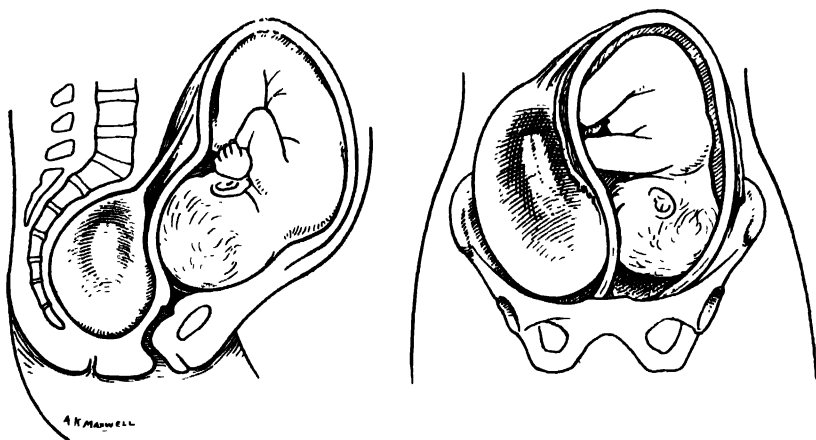


FIG. 227.—Ovarian Cyst complicating Labour. In left-hand figure the tumour is situated in the pelvis; in right-hand figure the tumour is above pelvic brim.

Large cystomata occupying the abdomen seldom interfere with the descent of the child, although they may become seriously injured.

Ovarian tumours are considered in detail in the gynæcological section (p. 995). As a complication of pregnancy they have been referred to already (p. 297).

The diagnosis of an ovarian tumour situated in the pelvis seldom presents any difficulty. It can be readily felt as an elastic swelling pushing the cervix most commonly to the side or forwards. But if the tumour is entirely confined to the abdominal cavity it may sometimes be difficult to define it, for it is often “tucked away” behind the uterus.

There is one condition which may closely resemble a cyst situated in the pelvis, *viz.*, sacculation of the gravid uterus (p. 290).

For the ovarian tumour first recognised during labour the ideal

treatment is to perform abdominal section, remove the tumour, and allow the child to be delivered by the natural passage. It is not often necessary to perform Cæsarean section for this condition. Even where there is difficulty in getting the tumour out of the pelvis after the abdomen is opened, it is generally possible to accomplish this by placing the patient in the Trendelenburg position and directing the assistant to push up the tumour with two fingers in the vagina.

Unfortunately, however, in domestic practice it is not always possible to carry out this treatment, nor is it practicable to have the patient transferred to hospital or nursing home. We must, therefore, indicate to our readers the alternative treatments which the general practitioner may employ.

The simplest procedure is to push the tumour out of the pelvis, and if the patient is placed in the knee-elbow position or the exaggerated left lateral position this is often possible. The labour is then allowed to progress naturally: operative delivery by forceps or by traction on the breech is only necessary if there is some other indication for interference. After the patient has convalesced from the parturition, ovariectomy is performed.

Sometimes, however, it is impossible to push up the tumour, either because of its large size or the adhesions to surrounding structures, etc. Should this be the case the accoucheur should incise the tumour through the posterior vault of the vagina and pack in a strip of sterilised gauze—this is a better procedure than simple puncture, which is often insufficient. He should then leave the delivery to nature or extract the child with forceps, or by traction on the limbs if the presentation is a breech. After the delivery of the placenta he should pull an end of the gauze into the vagina—the gauze should be removed in twenty-four hours. The idea of employing gauze in this way is that it anchors the tumour in the pelvis. As soon after the delivery as possible the patient should be placed under the care of a gynaecological surgeon so that the tumour may be removed. If there is too long delay the adhesions to bowel may become very intimate.

Tumours in the Recto-genital Septum.—Fortunately tumours of this nature are comparatively rare. They are referred to in the gynaecological section (p. 1050).

Encountered in obstetric practice, they may be very troublesome if they are of any size, for they cannot be pushed out of the pelvis and are difficult to reach even after abdominal section has been performed. If they are encountered for the first time during parturition the best procedure is Cæsarean section. On occasions they can be removed through the posterior vaginal vault and the child subsequently delivered by the natural passage—the writer has done this on two occasions.

Tumours of the Rectum.—Occasionally a carcinoma of the rectum is of such dimensions that it causes a certain degree

of obstruction. The obstruction is seldom very pronounced; but should this be the case Cæsarean section is the operation of choice. In Chapter XIV (p. 298) reference is made to this condition recognised in pregnancy.

FÆCES.—A loaded rectum may be mistaken for a tumour but only by the unwary. The characteristic feature is that it pits on pressure. An overloaded bowel inhibits rhythmic uterine contraction and sometimes causes “false” pains. As already mentioned (p. 399), it is most important to empty the bowel early in labour.

Bladder.—We have never encountered any case where a tumour or stone in the bladder has caused dystocia, although examples of these abnormalities have been recorded.

Overdistension of the bladder may cause delay in each stage of labour. In the first stage it inhibits uterine contractions; in the second stage it interferes with descent of the presenting part; and in the third stage it is one of the commonest causes of retention of the placenta (p. 554). We cannot emphasise too strongly the importance of keeping the bladder empty during labour.

Lastly, there is one other condition of the bladder which in multiparæ causes obstruction in the second stage of labour—viz., *cystocele*, or prolapse of the anterior vaginal wall (p. 843). The treatment is to keep the bladder empty and push up the prolapsed vaginal wall beyond the presenting part when it has descended low in the pelvis.

CHAPTER XXXII

COMPLICATIONS OF THE THIRD STAGE OF LABOUR

Retained and Adherent Placenta and Membranes—Manual Removal of Placenta and Membranes—Postpartum Hæmorrhage—Saline and Blood Transfusion—Intrauterine Douche—Inversion of Uterus—Air Embolism—Obstetric Shock.

WE consider in this chapter a number of complications of the third stage of labour, most of which are common occurrences although few need happen if this stage is carefully conducted.

RETAINED AND ADHERENT MEMBRANES AND PLACENTA

Retention of Membranes.—As already described (p. 379), the placenta with membranes attached comes away about half an hour after the birth of the child, and both should be complete. Very often, however, the membranes come away ragged and incomplete, and this is referred to as “retention of membranes.”

Incomplete membranes can always be recognised if they and the placenta are examined under water in a basin. This is not always done, and so very often portions of membranes are left unwittingly in uterus where they may undergo decomposition and set up a putrid endometritis (p. 643). If the incomplete bag of membranes is examined the amnion will generally be found intact; it is the chorion which is usually retained, for, as we have seen, the chorion and amnion are only loosely adherent. The amount of chorion left is variable, but very rarely is the whole of it retained. We would remind our readers that the decidual layer does not come away complete; tags always remain behind.

In some cases the fault is in the membranes: they are thin and friable. But more often the fault rests with the attendant, who has hastened the third stage. In most cases, therefore, the complication is avoidable.

It is specially prone to occur if retraction is unsatisfactory and if regular contractions do not develop after birth of the child. The condition is favoured by a prolonged labour, in which the uterus becomes exhausted. Undoubtedly, prolonged anæsthesia, and repeated doses of sedative drugs predispose to it also. But probably what

conduces to it more than anything is kneading the uterus immediately after birth of the child. This interferes with the quiet separation and descent of the placenta through "lower segment" and vagina, essential for satisfactory detachment of the membranes.

Treatment.—Obviously it is most undesirable to introduce the hand into the uterus postpartum. During the second stage intrauterine manipulations, such as version, are carried on inside the amnionic cavity, so that organisms which may be introduced are carried away with placenta and membranes as they are expelled. If, however, the hand is introduced for removal of membranes, organisms may be carried up by the hand and implanted on the ragged uterine surface.

If it is thought that *only a small portion* of membranes is left behind it is unnecessary to introduce the hand into the uterus; as a matter of fact, it is often difficult to find a small tag. Such small portions come away in the lochial discharge. Should, however, the *greater portion of membranes* be retained, it is advisable to remove it manually, as described later. Some obstetric teachers, however, are opposed to this procedure under any circumstances. They prefer to employ liquid extract of ergot by the mouth (1 dram) or ergometrine (1 mgm. by mouth or 0.5 mgm. intramuscularly) morning and evening, in the hope that the membranes will become detached and expelled.

Whole Placenta Retained.—Before referring to the ordinary causes of retention of the placenta mention must be made of an overdistended bladder—a cause not infrequently overlooked.

If labour has been prolonged, or sedatives and anæsthetics have been extensively employed, retraction and contraction of the uterus may be so unsatisfactory that there is not sufficient force to drive the placenta out of the uterine cavity. But, as in the case of retained membranes, the complication generally results from kneading the uterus and bringing about spasmodic contraction of the "retraction ring." Particularly rigid may be this retraction ring if ergot is given to hasten the delivery of the child (p. 436) or under the misguided idea that it may hasten the birth of the placenta—pituitary extract may have a like effect. This particular complication where the "retraction ring" holds up the placenta is known as *hour-glass contraction* of the uterus.

A retained placenta is associated with hæmorrhage if the placenta is completely or partially detached and the uterus atonic. But there is practically no hæmorrhage if the placenta is completely adherent and very little bleeding if oxytocics have been administered.

Treatment.—Normally, the placenta separates in fifteen to twenty minutes: the term "retention," therefore, can only be used if it remains unexpelled beyond thirty to forty minutes. The practice of introducing the hand into the uterine cavity for its removal is too frequently employed. Unless hæmorrhage demands immediate manual removal of the placenta the management of the third

stage recommended (p. 410) should be strictly followed. If the placenta cannot be expressed by Credé's method after an interval of thirty to forty minutes, it should be removed manually, as described later.

Portions of Placenta Retained.—This complication is unfortunately not infrequent, more especially should the third stage be hurried. If overlooked, serious consequences may result, for any portion of placenta left behind is liable to undergo decomposition and set up a putrid endometritis. Two other complications may develop—viz., secondary postpartum hæmorrhage (p. 562), and the formation of a placental polypus (p. 930). Consequently it is generally advisable to remove manually any portion of placenta retained. But here again some obstetricians counsel non-interference.

A retained portion of placenta will rarely be overlooked if the placenta is examined after it is expelled, for if any part is broken off and left behind this will be evident on careful inspection. But there is one condition in which a portion of placenta may be retained and escape notice although ordinary precautions have been taken to avoid it—viz., a *placenta succenturiata* (p. 310). This particular condition should be suspected if a punched-out hole is detected in the membranes near the placenta. If blood-vessels are discovered running from the placenta to this hole in the membranes that is proof positive of *placenta succenturiata*.

Adherent Placenta.—Here there exists an unusually intimate connection between the placenta and the uterine wall. There are two varieties of this condition : (a) one in which the attachment is slight, and (b) one in which the attachment is so intimate that there is great difficulty in detaching the placenta—this latter variety is known as *placenta accreta* and is very rare. In "*placenta accreta*" there is an absence of the decidua basalis ; the chorionic villi penetrate through the hyaline layer of Nitabuch into the muscular wall. The placenta is, as it were, plastered to the uterine wall, and the operator when attempting to remove it can find no line of cleavage. In not a few cases it recurs in successive pregnancies, and very often there is considerable degeneration of the placenta. Its treatment is detailed later (p. 558).

Where the whole surface of the placenta remains adherent there is, as stated above, no bleeding, but should the placenta be even slightly detached, bleeding may be profuse. The general experience is that there is a moderate degree of bleeding (due to a partial detachment) and that it is impossible to express the placenta.

MANUAL REMOVAL OF PLACENTA AND MEMBRANES

We have decided to describe this operation of Manual Removal of Placenta and/or Membranes at this point, rather than in association with other obstetrical operations.

Manual Removal of Placenta.—Manual removal of the placenta is an operation associated with a high maternal mortality and morbidity rate. The dangers are infection and shock. Infection is prone to occur because organisms are so readily carried into the uterus and implanted on the raw placental site; while shock is prone to aggravation because the hand has to be forced into the canal of a patient who, in many instances, has lost a considerable quantity of blood and may already be suffering from a degree of shock.

The operation, as already pointed out, is far too frequently performed. If the third stage is managed properly, postpartum hæmorrhage seldom occurs and the placenta is seldom retained; while a genuinely adherent placenta is a relatively rare complication.

Where the placenta has to be removed for immediate and severe postpartum hæmorrhage there is little time for disinfecting the hands. Here we have evidence of the advantage of wearing rubber gloves, which can be rapidly cleansed in antiseptic solution, or, better still, a fresh pair pulled on. If, however, the placenta is retained and there is little bleeding, or if it is adherent, there is time to make all preparations and to carry out the operation with fairly complete aseptic precaution, even although the delivery is carried out in the patient's home.¹ We will describe first the more elaborate operation of removal of an adherent placenta, later the procedure to be followed if the placenta is retained, and lastly the removal of retained membranes.

The patient should be placed in the lithotomy position with the pelvis brought to the edge of the bed or to the end of the operating table. In this position the final cleansing of vulva and inside of thighs is carried out as detailed elsewhere (p. 401).

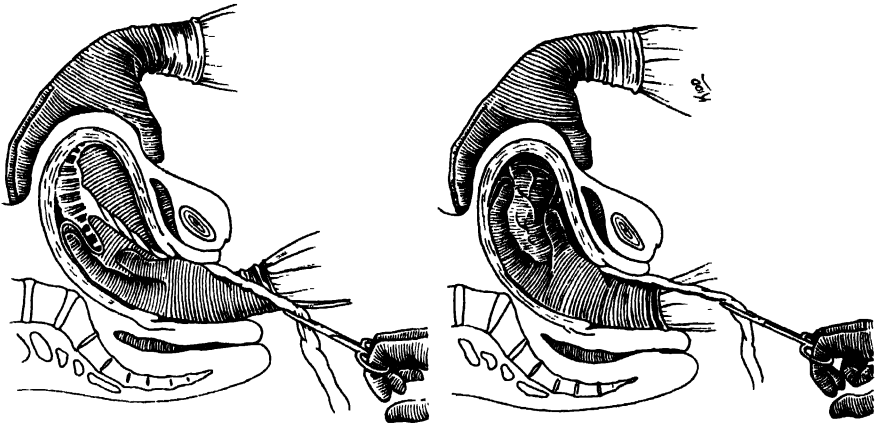
If the patient has lost much blood it will not be necessary to give her much general anæsthetic: but where the placenta is adherent or retained and there has been little hæmorrhage and no shock exists, deep anæsthesia is necessary to overcome the resistance of the vagina, cervix, and retraction ring. Gas and oxygen or spinal anæsthesia are the most suitable anæsthetics. The steps of the operation are as follows:—

A nurse is instructed to hold the umbilical cord taut. The operator places one hand over the fundus to steady the uterus and press it downward on to his other hand introduced into the vagina. The internal hand is passed up along the cord which guides it through the cervix to the placental site. *This ensures that the hand is passed inside*

¹ A patient who is suffering from severe postpartum hæmorrhage should not be transferred to hospital—it is for this particular emergency that an emergency unit ("flying squad") may be of great service. Naturally such a service is only feasible in large urban centres. The results of the emergency service instituted by Farquhar Murray for Newcastle and District are excellent (*vide B.M.J.*, 24th September 1938). On the other hand, if the condition is an adherent placenta with little bleeding or shock the patient may be safely removed by ambulance to hospital, and this procedure should be followed.

the amnionic sac (Fig. 228). When the placenta is reached the membranes are pushed in front of the fingers all round the margin of the placenta until it is completely detached (Fig. 229). If gentleness is exercised, this can usually be done without tearing the membranes. The internal hand should now grasp the placenta which has been detached, and it and the hand should be withdrawn while the external hand assists the process by pressure on the fundus. The patient should then be given 1 c.c. pituitary extract and, if deemed advisable, an intrauterine douche of normal saline (118° F.).

The whole operation should be carried out with one introduction



FIGS. 228-229.—Manual Removal of Placenta.

In Fig. 228 a nurse or assistant holds cord taut by means of pressure forceps. The operator passes his hand (left) up along cord which guides him to placenta. With his other hand (right) he steadies the fundus externally. He pushes the membranes in front of his fingers as he detaches the placenta. In Fig. 229 the operator has detached the placenta almost completely by pushing membrane before his fingers further and further between placenta and uterus wall—he is shown grasping whole placenta prior to removing it. The operation should be carried out with one introduction of hand.

of the hand. *Each reintroduction of the hand adds to the risk of infection.*

When the operation is carried out as described, all manipulations are performed inside the amnionic sac, so that any organisms which happen to be carried into the sac are swept away when the placenta and membranes are removed. Furthermore, there has been no possibility of direct implantation of organisms on to the placental site.

In recent years an old method known as the *Majon-Gabaston method* has been revived. It consists in injecting the placenta with normal sterile saline solution through the umbilical vein of the cord. This has the effect of distending the villi of the chorion so that the placenta becomes “ballooned up” and is readily detached with the assistance of Credé’s manœuvre and slight traction on the cord. We notice that in some descriptions it is stated that this results in the formation of a *retroplacental hydroma*, but unless there is extensive tearing of the

placenta, an occurrence which cannot take place with an adherent placenta, little fluid escapes from the villi.

The operation is very simple. The cord is cleansed for about 9 inches from the vulva with spirit. A needle is inserted into the vein and 300 to 400 cm. saline solution is injected. The operation is very favourably commented upon by Currie, of Leeds. It has been extensively employed in many clinics on the Continent, in the United States of America, Canada and elsewhere. This particular treatment is never successful with placenta accreta.

The manual removal of placenta accreta may be most difficult. Indeed, many obstetricians advise hysterectomy. Should the condition be encountered in domiciliary practice it is better to cease attempts at manual removal, and to transport the patient to hospital or nursing home. This can be done with safety as there is little if any bleeding with this complication.

Retained Placenta.—With this complication the patient's condition may be more serious, as she may have lost a considerable amount of blood. On the other hand, the actual removal of the placenta may be easier provided there is no constriction at retraction ring ("hour-glass contraction") (p. 554).

If the patient is not much collapsed the removal should be immediately carried out. If, on the other hand, the patient is extremely collapsed (when active hæmorrhage will have almost ceased) she should be given a blood transfusion beforehand, should facilities for doing so be available. In the event of blood transfusion not being feasible—*e.g.* if the patient is confined in her home and isolated in the country—removal of the placenta should be undertaken and she should be given pituitrin (1 c.c.) and an intravenous or intracellular saline infusion (*vide* p. 564). A blood transfusion given subsequently is of enormous benefit as it hastens very much her convalescence.

Removal of a retained placenta is only difficult if there is a constriction at retraction ring ("hour-glass contraction"); then caution must be exercised in forcing the hand through the constriction. It is better to push down the body of the uterus on to the internal hand by exerting pressure with the external hand grasping the fundus. If undue force is exercised in pushing up the internal hand, a laceration in the lower uterine segment may result (p. 599). Of great value in many cases (but not in all) is to give *amyl nitrite* (6 to 10 minims) in the usual manner. The action of this drug is rapid, but very transitory. Should it have the desired effect complete relaxation of the constriction ring results and the placenta can be easily removed.

Manual Removal of Retained Membranes.—This operation, in so far as infection is concerned, is more dangerous than removal of the placenta, because the raw surface of the uterus is scraped with the hand, whereas in removal of an adherent placenta the manipulations are

carried out within the amnionic sac, as already explained. On the other hand, the patient is generally not seriously collapsed from hæmorrhage or shock ; and if by any chance she should be, the necessity for removing the membranes is not so urgent as is the case with retained placenta. Indeed, as pointed out (p. 554), some obstetricians are opposed to introducing a hand into the uterus to remove membranes under any circumstances.

With the left or external hand steadying the fundus, the right hand should be passed into the vagina. Very often a portion of membranes is felt hanging through the cervix ; if so, it should be carefully grasped and steady traction made upon it. If, however, the retained membranes cannot be removed in this simple manner the hand has to be passed into the uterus and its surface scraped with the fingers. All débris and blood-clot are then removed. Here again, and even more so than in removing a placenta, *it is advantageous that the operation should be completed with one introduction of the hand*. Following removal of membranes the uterus should be douched with normal saline solution and pituitrin (1 c.c.) administered intramuscularly.

POSTPARTUM HÆMORRHAGE

In a normal labour the patient loses from 5 to 10 ounces of blood. Hæmorrhage in excess of that quantity is termed "postpartum hæmorrhage." Of the deaths directly due to pregnancy and childbirth postpartum hæmorrhage is responsible for approximately 6 per cent. (p. 756).

Postpartum hæmorrhage is encountered in two forms : (a) primary ; (b) secondary. By *primary postpartum hæmorrhage* is meant free hæmorrhage before or immediately after the birth of the placenta. Should it occur before expulsion of placenta it is sometimes referred to as "third stage hæmorrhage." By *secondary postpartum hæmorrhage* is meant free hæmorrhage occurring some hours or days after delivery.

Primary Postpartum Hæmorrhage.—Before considering the causes of postpartum hæmorrhage we would remind our readers of the conditions in the uterus which normally prevent the occurrence of hæmorrhage. The uterus after delivery is in a condition known as "*retraction*," and from time to time it passes into a state of "*contraction*." *It must be clearly understood that postpartum hæmorrhage is prevented normally by retraction, not by contraction.* No organ could remain permanently contracted : the muscle would sooner or later become exhausted. Retraction of the muscle fibres closes the large uterine sinuses and prevents hæmorrhage. Although clotting in the vessels occurs later, deficiency in coagulability of the blood is only of secondary importance.

The causes of postpartum hæmorrhage are therefore all conditions which interfere with retraction and contraction of the uterus. To say

that the condition results from "atony" of the uterus is not a sufficient explanation, for that simply means that the uterus is not retracting and contracting. We must determine what is the cause of the uterine atony. Now, one of the commonest causes of atony is uterine exhaustion. There are several predisposing causes to this exhaustion—multiparity associated with frequent child-bearing is very important, debility, overdistension of the uterus, antepartum hæmorrhage, chronic subinvolution and the presence of fibroid tumours, and lastly a hormonal dyscrasia deserve mention. Over such causes the accoucheur has little control. But in point of fact, although they may play a part in the causation of postpartum hæmorrhage, they are not so important as mismanagement of the third stage of labour. (Overstimulation of the uterus, or neglecting to follow down the retracting uterus with the hand during and after delivery of the child, leads to unsatisfactory separation of the placenta and free bleeding into the uterine cavity. Next in importance to faulty management of the third stage come prolongation of labour and long-continued anæsthesia. *The three important causes of postpartum hæmorrhage are faulty management of the third stage, unduly prolonged labour, and the too free administration of anæsthetics and sedative drugs.* Postpartum hæmorrhage is therefore in most instances a preventable complication.

Having considered the ordinary variety of postpartum hæmorrhage, two others call for special reference. In a few cases the hæmorrhage is *traumatic in origin* and results from tears in the canal, more especially in the cervix. A hæmorrhage of such origin is to be distinguished from ordinary postpartum uterine hæmorrhage by the fact that in the former the uterus is firmly retracted, while in the latter it is in a condition of atony. The other condition is *shock*, which is discussed elsewhere (p. 571). In most instances shock is the result, not the cause, of the excessive hæmorrhage; but in a few instances shock by inhibiting uterine retraction and contraction is primarily the cause of the hæmorrhage.

DIAGNOSIS.—Our readers might think that it is hardly necessary to say anything regarding the symptoms and diagnosis of this condition, as bright red blood pouring from the vagina is only too obvious. But in not a few cases the hæmorrhage is not obvious, as the blood poured out accumulates in the atonic uterus, which becomes distended in consequence. Such insidious hæmorrhage is liable to be overlooked. This, however, should not occur provided the attendant accoucheur keeps his hand on the fundus of the uterus during the third stage, and, after delivery of the placenta, makes it a practice never to leave the patient's bedside until he is satisfied: (a) that the uterus is well retracted; (b) that the pulse is good as regards rate and quality. *Rapidity of pulse is most significant of insidious intrauterine bleeding.*

Should severe hæmorrhage occur, the usual symptoms of exsanguination develop—pallor, rapid soft pulse, faintness, restlessness,

sighing respirations, unconsciousness, coma, possibly convulsions, and death.

TREATMENT.—The *prophylactic treatment* of postpartum hæmorrhage is the proper management of the third stage of labour (p. 411).

Active Treatment before the Birth of the Placenta.—The hand should be introduced into the uterus and the placenta removed. An intrauterine douche should then be given, and 1 c.c. of pituitary extract injected intramuscularly. The manner in which the placenta is to be removed and the precautions to be taken have been already described. It need hardly be stated that, prior to introducing the hand, attempts should be made to expel the placenta by Credé's method (p. 410); *but only if the uterus can be stimulated to contract—to attempt to express the placenta from an atonic uterus may cause inversion of uterus (vide p. 568).* We have purposely mentioned manual removal first, because owing to the atonic condition of the uterus it is generally impossible to express the placenta and valuable time is lost in attempts to do so. *In cases of extreme collapse manual removal of placenta should be delayed until an intravenous transfusion has been given (vide p. 556).*

After Birth of the Placenta.—As the control of postpartum hæmorrhage is satisfactory retraction of the uterus, the first object should be to secure this. An intrauterine douche of normal saline at a temperature of 116-118° F. and 1 c.c. of pituitary extract should be given immediately. Ergometrine may be given later to establish more continuous retraction—the dose by mouth is 1 mgm. and intramuscularly 0.5 mgm. Ergot by the mouth in the form of the liquid extract of ergot (1 dram) is suitable for slight postpartum hæmorrhage, but too slow in its action for the graver forms.

Very seldom indeed will it be found that massage of the uterus, a hot intrauterine douche and pituitary extract fail to bring about retraction and contraction, and so control the bleeding. If a large quantity of blood-clot is retained and cannot be expressed or washed out by intrauterine douching, it may be necessary to clear it out with the hand. Apart altogether from the fact that by the hand all blood-clot, etc., can be removed, the hand stimulates the uterus to contract.

Practically all serious postpartum hæmorrhage can be successfully dealt with by following the instructions just given. But should these measures fail to control the bleeding, one of the two following alternative procedures must be employed. One consists in *compressing bimanually the uterus* in the manner shown in the illustration (Fig. 230). A hand is passed into the vagina and grasps the cervix, while the other or external hand doubles the fundus on the cervix, the uterus being firmly compressed between the two hands. This is only an

emergency measure for arresting profuse and uncontrollable bleeding, but it may be kept up for some considerable time until retraction of the uterus is secured.

An alternative procedure is *pressure on the aorta* with the closed fist. Here the aorta is compressed between the closed fist and the vertebral column. To carry out this method satisfactorily the operator must be well above the patient so that the forearm can be maintained fully extended—it is impossible to keep up pressure for any length of time with the arm flexed.

An elastic tourniquet applied round the abdomen has been suggested, but it may do serious injury to the vessels and has consequently never been generally employed.

In the very worst cases the *uterine cavity may be plugged*. Long strips of thick sterilised gauze are firmly packed into the uterus and vagina, a pad is placed over the fundus, and a binder applied round the abdomen. It is seldom that the accoucheur in domestic practice has gauze at hand: consequently this treatment is generally only possible in hospital prac-

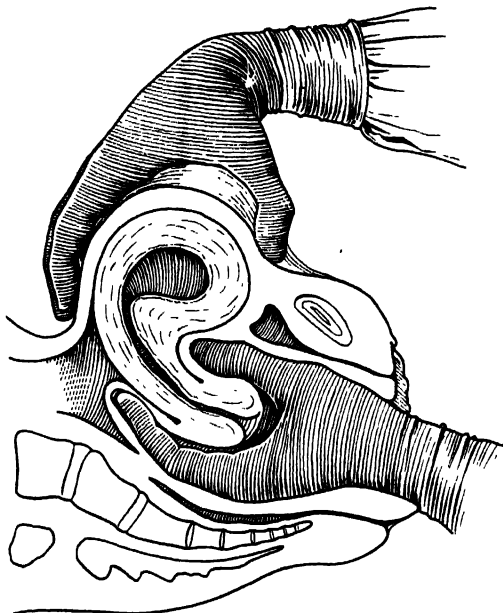


FIG. 230.—Bimanual Compression of Uterus.

tice. We have very seldom found it necessary to employ this method of treatment. When employed, the uterus must be properly packed as shown in illustration (Fig. 231). Large quantities of gauze are required.

Traumatic Hæmorrhage.—This variety should be treated by careful stitching of the laceration (*vide* p. 597).

Secondary Postpartum Hæmorrhage.—By secondary postpartum hæmorrhage is understood—hæmorrhage which occurs any time in the puerperium after the first few hours. The most common cause is retention in the uterus of blood-clot, pieces of membrane, but especially pieces of placenta. Sometimes it is purely the result of subinvolution; but in such cases the amount of hæmorrhage is usually slight. *In a few cases quite free hæmorrhage may occur in the third or fourth week of the puerperium, in which apparently the only cause is a backward displacement of the uterus.* A submucous myoma calls also for mention as a cause—it may be associated with very severe hæmorrhage.

Lastly, *chorion-epithelioma* must not be forgotten. With this latter tumour the bleeding usually does not come on until three or four weeks after parturition (p. 984). We particularly stress the importance of excluding chorion-epithelioma, which can now be done by having a Aschheim-Zondek or Friedman's test carried out.

Treatment.—If the hæmorrhage is only slight, ergot (liquid extract, a teaspoonful morning and evening) or ergometrine should be given for a week, and the patient kept at rest in bed. Hot intrauterine

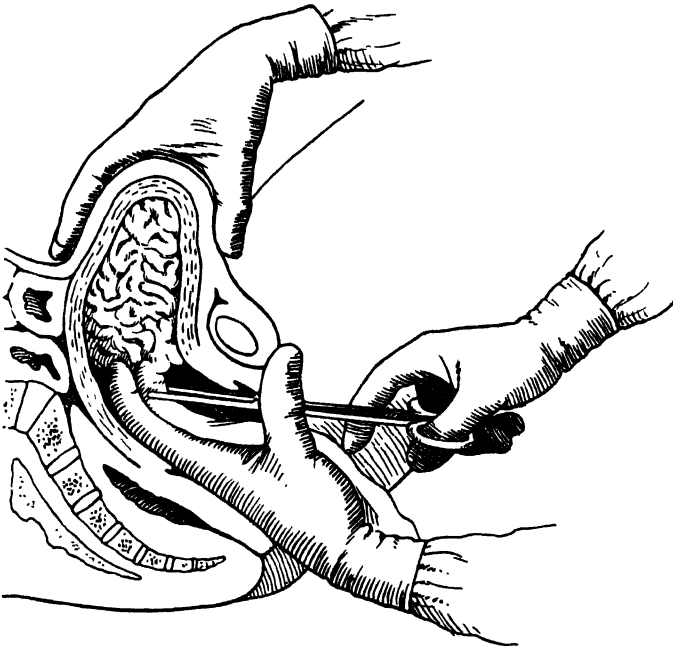


FIG. 231.—Packing the Uterus with Gauze. Note how carefully the operator is packing the body of the uterus. The mistake is sometimes made of packing only the lower segment, which is obviously a futile procedure.

douches (115° F.) may be given. If the bleeding is not arrested by these simple means the uterus should be explored. If at all possible this exploration should be done by two fingers, and it is often possible, as the cervix may be still easily dilatable. *We would warn our readers to be most careful if a curette is employed; the wall of the uterus is very soft and may be readily perforated. Any displacement of the uterus should be corrected, while a submucous myoma should be removed. In the case of chorion-epithelioma total hysterectomy is naturally the treatment.*

SALINE AND BLOOD TRANSFUSION

Although arresting the hæmorrhage is of the first importance, and is generally all that is necessary, there are a number of cases in which the patient is so collapsed from loss of blood that she may actually succumb unless there is introduced into her circulation some fluid which will take the place of the blood lost and relieve the shock and syncope. This raises the whole question of transfusion of normal saline solution whole blood, blood serum, and dried serum or plasma.

Normal Saline Solution.—Normal saline solution consists of 1 dram of salt to the pint of warm water (100° F.), and it may be injected into the rectum, the cellular tissue, or directly into a vein.

For the slighter cases 1 to 1½ pints of the solution *injected into the rectum* is sufficient; but in graver cases the saline solution is so slowly absorbed from the rectum that it is necessary to introduce it either into the cellular tissue or into a vein. *Intracellular infusion* is very easily carried out: all that is necessary is an aspirating needle, tube, and a filler. The fluid may be run into the cellular tissue in any region, but the best sites are the submammary tissue and the loose cellular tissue of back or abdominal wall. It is a mistake to inject too much into one area. A pint under each breast is sufficient. In the graver cases, however, it is necessary to introduce the *saline solution directly into a vein*. The median basilic is generally selected. The skin over the forearm is carefully cleansed, the vein isolated, two ligatures applied round it, so that they may be tied after removal of the needle. A small straight needle is passed directly into the vein, and 1 to 2 pints of the solution are allowed to enter slowly. The addition of glucose (10 per cent.) adds to the efficacy of the saline solution, but is of transient value. The addition of gum acacia (6 per cent.), at one time favoured, is not without danger and is now generally discouraged.

Blood Transfusion.—Blood transfusion may be employed with great advantage in conditions associated with profuse hæmorrhage.

In most large cities services of donors have been arranged—London, for example, has an excellent general service. In other cities each hospital makes its own arrangement. In the larger hospitals blood is stored in bottles placed in a refrigerator so that it is available when required. Further, since the outbreak of the war “Blood Banks” or distributing centres have been established throughout the country.

Securing Suitable Donor.—After determining the blood group to which the patient belongs, the appropriate donor is secured: but in addition a direct compatibility test is carried out before proceeding further. In extreme emergency, blood from a Group IV donor may be

given without preliminary testing, especially if the "drip" method is employed.¹

The donor's arm is properly prepared, the veins being distended by use of a tourniquet. The skin over the selected spot should be infiltrated with novocain. Thereafter, a short straight needle of fairly wide bore, with its rubber tubing attachment, is introduced into the vein and the blood allowed to flow along the tube. The blood is received into narrow glass cylinders, each of 400 c.c. capacity and containing 50 c.c. of a 3.8 per cent. sodium citrate solution; 700 c.c. of blood can be run off in a few minutes, making a total of 800 c.c. of citrated blood.² The needle is withdrawn and the puncture sealed. The cylinders are placed in a basin of water at blood heat, and the mixture kept rotating gently until its transference to the apparatus by which the transfusion is given to the patient. Transfusion may be carried out without cutting down on a vein; but if the veins are small it may be necessary to dissect out the recipient's median basilic vein (after infiltration with novocain) and introduce the blood directly into the vein, which is tied off at the conclusion of the operation: the skin is then sutured. Thirty to forty minutes should be taken to give the transfusion.

The simplest transfusion apparatus is a cylindrical glass vessel, rubber tubing and a glass cannula for insertion into the vein. Some surgeons advocate the slow intravenous "drip," continuing the blood transfusion over a period of twelve to sixteen hours: and in addition the "bubbling" of oxygen very slowly into the blood container to prevent sedimentation of the blood in the small needle used in this method. The technique of this method is more complicated and may be more disturbing to the patient. The advantages of the method can be secured by repeating the blood transfusion by the ordinary method if this is deemed necessary.

WHOLE BLOOD AND BLOOD PLASMA OR SERUM STORED IN BOTTLES AND DRIED HUMAN SERUM OR DRIED HUMAN CITRATED PLASMA.—

¹ A most interesting and important discovery has recently been made; viz., that human blood contains a hitherto unrecognised agglutinin which has received the term Rh. While the blood of 85 per cent. of individuals (white) contains this agglutinin 15 per cent. do not possess it. Furthermore, if an individual of the latter group (negative Rh) receives a transfusion from the blood obtained from an individual who is Rh positive anti-Rh agglutinins may develop in his or her blood, with the result that he or she will treat subsequent Rh positive blood as incompatible. The picture in serious cases is similar to that following transfusions of blood of incorrect A.B.O. group—jaundice, hæmoglobinuria, suppression of urine, lumbar pain, a rising blood urea; and death may result.

For obstetricians this discovery has peculiar interest. If a woman (Rh negative) becomes pregnant with an Rh positive fetus (the Rh agglutinin having been inherited from the father) the mother may be sensitised to Rh positive blood, with the result that should the mother receive a transfusion of ordinary stock blood a grave hæmolytic reaction may follow. A suspicion that the mother has been so sensitised should be aroused if the fetus presents manifestations of *Erythroblastosis foetalis* or if at a previous birth the child has manifested symptoms of this disease.

Some of the larger "Blood Banks" now retain a supply of blood suitable for Rh negative patients.

² Recently the Medical Research Council have recommended the addition of 20 c.c. of 15 per cent. glucose—use 120 c.c. for 420 c.c. of blood.

These different methods of storage have revolutionised and simplified blood transfusion for hæmorrhage and shock.

Bottled Whole Blood.—This must be kept in a refrigerator at a temperature of from 2° to 5°, but it must not be allowed to freeze. It may be used up to fourteen days' storage.

Blood Plasma or Serum in Bottles is much simpler to store as it need only be kept in a cool and dark place. Blood serum is simpler to handle—the average yield is 40 per cent. of the blood volume. It can be kept for months in storage ready for use, provided it does not become turbid. It is an excellent substitute for whole blood in cases of shock, but not so good in cases of profuse hæmorrhage for which whole blood is most suitable. A simple apparatus for administering the blood or serum can immediately be attached to the bottle of blood or serum. In most cases it is not necessary to expose the vein; the needle can be introduced direct into the vein.

“Blood banks” and distributing centres for both whole blood and serum have been established throughout the country. Every hospital, even the smallest cottage hospital, should have an adequate supply of both whole blood and blood serum ready for use—the blood bottles should be renewed every fourteen days from the nearest local blood distributing centre.

Dried Human Serum.—This is put up in flat bottles in the form of flakes, and each bottle contains the solids from 200 c.c. of serum. The flakes are dissolved in 200 c.c. of distilled water, if normal concentration is desired—this takes about ten minutes, and the solution contains 7 per cent. protein. If employed in double strength the solution takes twenty minutes, and gives a protein content of 14 per cent. The solution must be used immediately and cannot be stored.

INTRAUTERINE DOUCHE

We have referred frequently to intrauterine douching, more especially for the removal of debris after an abortion and for the purpose of stimulating uterine contraction when there is undue post-partum hæmorrhage. The accompanying illustration (Fig. 232) shows a very convenient method of carrying out this operation in domestic practice. The nozzle attached is a large glass one, which is quite suitable for douching in postpartum cases at term, for the return flow readily escapes through the dilated cervix. A two-way flow nozzle as illustrated (Fig. 233), but of a larger size, is preferable. Where douching is employed after removal of an incomplete abortion, or after curettage of the non-gravid uterus, the two-way flow nozzle should always be employed, as otherwise fluid may be forced through the Fallopian tubes into the peritoneal cavity. This accident may also occur, but is less likely, during intrauterine douching of the puerperal uterus. To guard against such a possibility a hand should

be applied over the fundus and from time to time the uterus should be massaged to prevent the cavity being ballooned up with fluid.

An objection urged against the Rotunda siphon tube is that it is sometimes a little difficult to get all the air out of the tube, and this

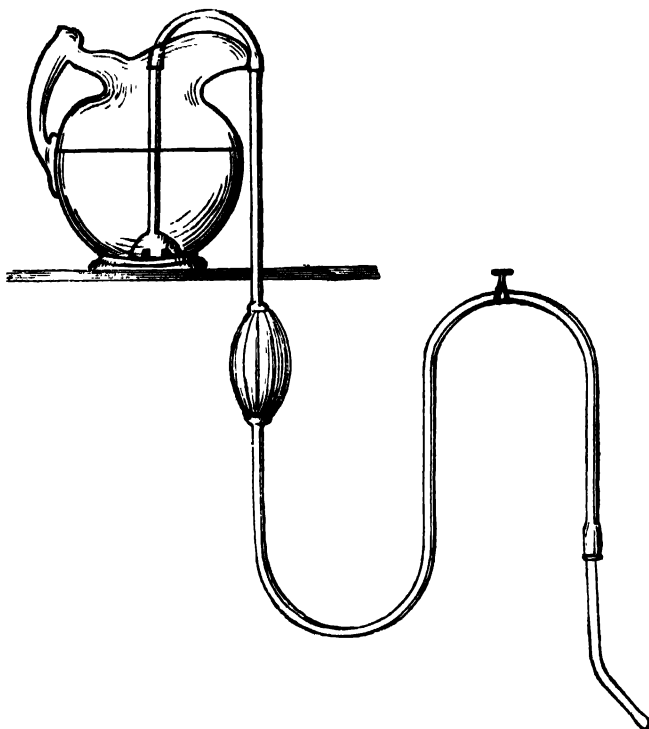


FIG. 232.—Rotunda Siphon Douche Tube with Intrauterine Nozzle. The strength of the flow is controlled by raising or lowering the ewer here shown. The arrangement is specially suitable for domestic midwifery, as the tubing can be easily sterilised and carried with the obstetric outfit.

is of importance, for if air is forced into the uterus with the solution it may be driven into the open sinuses and air embolism may result. The writer has never witnessed any accident following careful



FIG. 233.—Bozeman-Fritsch's Two-way Intrauterine Nozzle, suitable for Use after Curettage. For douching the puerperal uterus a much larger-sized nozzle is employed.

employment of the siphon douche. Naturally, a glass reservoir on a standard, as used in a modern labour room, is preferable.

Intrauterine douching should be carried out with discretion and great care after removal of an ovum or a full-time foetus, as infection may readily be conveyed into the uterine cavity from the vagina.

In connection with this conveyance of infection into the uterine cavity we would emphasise the special danger of such an occurrence where the intrauterine douche is employed in septic conditions of the puerperal uterus. In such cases the vulva and vagina are always heavily infected. The correct technique if intrauterine douching is deemed advisable (a procedure we do not favour as a routine) is to disinfect the vagina, pull down the cervix with volsella and carefully disinfect the cervix before passing the uterine nozzle into the cavity. This almost necessitates anæsthetising the patient; indeed, we are convinced that it is advisable. The common practice of simply carrying up the douche nozzle through the cervix under protection of the fingers in the vagina, although it is more convenient in ordinary domestic practice, is dangerous.

The solution used for intrauterine douching will depend upon the object aimed at. When it is a matter of washing out débris or stimulating the uterus to contraction in postpartum hæmorrhage normal saline solution (116° to 118° F.) is best. The same applies after ordinary curettage for non-puerperal conditions, only the temperature of the water need not be higher than 112° F. But if the douche is *employed as a germicide* in puerperal infection of the uterus then an antiseptic solution must be used, and if it is to be of any service it must be fairly strong. Although it may be argued that Dettol, tincture of iodine, or mercurochrome in weak solution is better than normal saline solution, it is very doubtful if *antiseptic* douches are of much value: indeed, it is maintained by some that they are really injurious. As pointed out elsewhere, we prefer other remedies to intrauterine douching with strong antiseptics in infections of the uterine cavity (*vide* p. 652).

OTHER COMPLICATIONS FOLLOWING BIRTH OF CHILD

Inversion of the Uterus.—This accident occurring immediately or shortly after the birth of the child is termed “acute inversion.” The other form, known as “chronic inversion,” which may result from an acute inversion left unrecognised, or from a submucous fibroid which has been forced out through the cervix, is considered in the gynæcological section (p. 862).

VARIETIES AND FREQUENCY.—Three degrees of inversion are generally described: (1) where there is only a slight inversion, the fundus reaching to the internal os; (2) where the whole body of the uterus is inverted up to the internal os; (3) where the uterus and cervix are completely inverted (Fig. 234). It is probable that a considerable number of the first variety occur without being recognised, the inversion righting itself by active uterine contractions. The accident occurs very rarely. Some writers place the frequency at 1 in 30,000, others at 1 in 100,000 deliveries; in point of fact, we have no means by which an accurate estimate can be made.

ÆTIOLOGY.—Inversion of the uterus may be brought about by a localised atony, more particularly of the placental site, along with active contractions of the rest of the uterus. Usually, however, in addition to a localised or general atony of the body, there must occur : (a) increased intra-abdominal pressure from coughing, sneezing or straining ; or (b) pressure from above by the hand of the doctor or nurse ; or (c) dragging on the cord from below.

In most instances the inversion occurs spontaneously from increased abdominal pressure, coming on quite suddenly during a fit of coughing, sneezing or straining. Undoubtedly, however, the too energetic employment of Credé's manœuvre for expressing the placenta, where

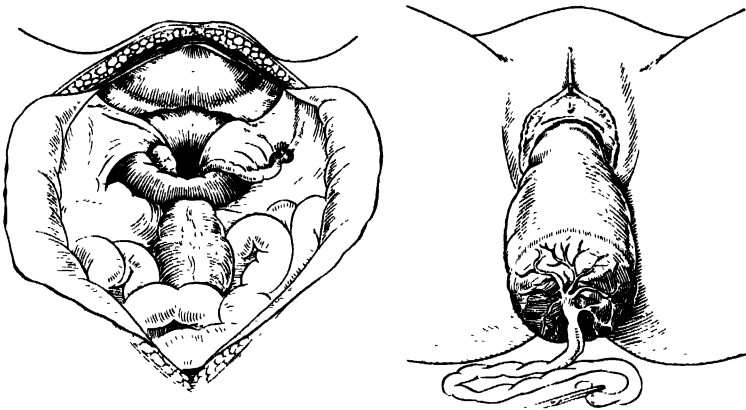


FIG. 234.—Inversion of Uterus and Vagina. The figure to the left shows appearance of Inversion from above ; that to the right, a Complete Inversion of Uterus and Vagina with Placenta still attached. There is a figure on page 863 which shows a chronic inversion.

nurse or doctor have attempted to do this while the uterus is in a state of atony, accounts for some of the cases ; whilst in a few, traction on the cord is undoubtedly responsible. All writers stress the fact that in a large proportion of cases the placenta is situated right over the fundus as in accompanying-right hand figure.

SYMPTOMS AND DIAGNOSIS.—As a rule, the symptoms of this accident are very pronounced. Generally there is a feeling of something coming down, quickly followed by less or more pronounced collapse from shock. Hæmorrhage may not be a prominent feature—this applies, at least, to those cases where inversion is complete. Where inversion is of a slighter degree, and the fundus does not come beyond the os externum, only pain and hæmorrhage may be present.

In a few cases the symptoms are so slight that days and sometimes even weeks may pass before it is recognised. To such cases as already stated the term “chronic” inversion is applied.

The condition which simulates inversion of the uterus is a sub-mucous myoma projecting through the os ; but in such a case the enlarged uterus can be felt above the pubes, while with inversion

careful bimanual examination will reveal a depression over the fundus. Even with slight inversion this depression can be felt. If the fingers are passed into the vagina, the inverted body of the uterus can be felt, and above and encircling it the ring of the convex.

PROGNOSIS.—The prognosis of inversion of the uterus is very much better to-day than in former times, for it is less likely to be overlooked and sepsis is less likely to follow. Still, the number of fatalities is not inconsiderable.

TREATMENT.—The reduction of an acutely inverted uterus is usually accomplished without much difficulty. It is commonly recommended to replace by taxis first the part that became last inverted, very much in the manner recommended by surgeons for the reduction of a hernia. In cases where the *whole* uterus is infected this is seldom difficult; but if the “retraction ring” is firmly contracted while the inverted cervix and lower uterine segment can be reduced, there may be difficulty in pushing the body through the ring. It is important to remember that it is generally the retraction ring that prevents reduction, not the cervix, which is flaccid after delivery. The employment of force is dangerous, as the thinned-out and non-resistant lower segment may be torn. The vaginal vault has also been torn in some instances. Amyl nitrite, so useful, as has been pointed out, in overcoming the spasm in “hour-glass contraction,” may be employed in this condition also, provided shock is not pronounced (*vide* p. 558).

If the patient is in a condition of shock, attempts at reposition should be delayed till the symptoms of shock have passed.

Anæsthesia facilitates the carrying out of these manipulations. After replacement, and especially if chloroform has been freely given, there is a distinct danger of postpartum hæmorrhage. This can be controlled by pituitary extract and a hot intrauterine douche, which should always be given after replacement.

In not a few cases the uterus has become inverted with the placenta still adherent (Fig. 234). In such an event it is generally recommended to attempt replacement with the placenta still attached, as this gives a certain degree of protection to the uterus—having replaced the fundus the placenta should be manually removed.

Where reduction fails, various methods of treatment have been advocated. To-day many obstetricians recommend immediate abdominal section—in this type of acute inversion replacement from the abdomen is generally easy. Others prefer less radical measures as in some instances spontaneous rectification occurs. We have seen how frequently a retroverted gravid uterus spontaneously rights itself (p. 287).—Occasionally the inverted uterus does likewise if hot vaginal douches are given twice daily, and subsequent attempts made at replacement. In this class of case, after the lapse of ten days or so, special repositories, such as Aveling's, may be employed; it is of great advantage to select a cup to suit the size of the uterus (p. 864).

In commenting upon immediate abdominal section *versus* a more conservative procedure, we would advise the decision being based on the degree of shock present.

Air Embolism.—Entrance of air into the uterine sinuses and thence to heart and vessels of the lungs has been described by a number of writers. It is well to remember, however, that certain gas-producing organisms may have accounted for the air bubbles discovered at a post-mortem examination in some of the cases recorded. But even although we admit such a possible error, examples of air embolism do undoubtedly occur. It has been claimed that the left lateral position predisposes to this accident. The condition is associated with exactly similar symptoms to those present in pulmonary embolism and thrombosis, described later as a complication of the puerperium (p. 663).

Obstetric Shock.—The subject of shock is much discussed at the present time, but as regards its ætiology there are still differences of opinion. All are aware that surgical shock is favoured by previous fatigue, prolongation of operation, loss of blood, and prolonged anæsthesia, more especially chloroform anæsthesia. But the exact manner in which the nervous system is affected and primarily contributes to shock is still under discussion.

As regards *obstetric shock*—namely, the shock following a parturition—we find it not uncommon, after extremely difficult and prolonged labours and where there has been a considerable loss of blood.

Certain operative procedures definitely predispose to its occurrence—*e.g.* forcibly dilating the cervix prior to extraction, dragging the child through the cervix with forceps, bringing down the extended limbs in breech presentations, version in cases where the liquor amnii has drained away for some considerable time, manual removal of the placenta after a prolonged labour, and rough and unintelligent attempts to expel the placenta. Undoubtedly, also, certain conditions of the patient prior to delivery are causative factors. It is more prone to occur in women who have lost large quantities of blood during pregnancy or early in labour from placenta prævia or accidental hæmorrhage; in women who are generally debilitated and anæmic, and in women the subjects of toxæmia from whatever cause. It must also be remembered that any operative interference in which serious injuries have been inflicted on the parturient canal, especially severe laceration of the cervix and uterus, apart altogether from the loss of blood which may be associated with them, distinctly favour the occurrence of shock. *We would stress the unfavourable influence exerted by a progressive acidosis.* When this occurs to a marked degree in the course of labour, conditions are very favourable for the occurrence of shock. It is obvious, therefore, why an anæsthetic such as chloroform is dangerous under certain conditions (p. 413). We would stress particularly the dangers of *repeated* chloroform anæsthesia.

Occasionally, however, examples of shock occur where the parturition has not been severe and there has been no obvious cause for the occurrence. Such are probably examples of the *neurogenetic* as distinguished from the *traumatic* type of shock. Fear, dread of pain, or pronounced sensitiveness to pain tend to induce shock. It is of enormous advantage, therefore, if patients presenting such symptoms are given morphia and scopolamine during labour.

TREATMENT.—*The treatment of shock* is (a) Preventive ; (b) Active. *Under Preventive Treatment* are included : (1) Approved management of labour so that exhaustion is reduced to a minimum and every possible means taken to prevent infection. This is secured by plentiful supplies of fluids containing starch and sugar during labour ; removal of all fear, as referred to above ; and employment of strict antiseptic precautions. (2) If operative measures have to be employed to effect delivery, reflexes from vagina and especially from pelvic floor should be removed by local and/or general anæsthetic. (3) If a general anæsthetic is employed, discretion must be exercised in the selection of the anæsthetic—particularly dangerous is the employment of *repeated* chloroform anæsthesia, and the use of this drug is contraindicated should any toxæmic condition be present. (4) Lastly, it is most important that the patient be surrounded by blankets with a hot-water bottle at her side. *One must never forget that the parturient loses heat and a great deal of fluid during labour.*

Active Treatment.—Restoratives should be administered. Those usually given are digitalin, gr. $\frac{1}{60}$; strychnine, gr. $\frac{1}{10}$; and pituitrin, 1 c.c. The component of the latter extract—viz., *pitressin*—which raises blood-pressure, is particularly indicated. Intravenous saline with bicarbonate of soda to the volume of 1 pint with 10 per cent. glucose ought to be given at once ; this is an especially valuable procedure even if a blood transfusion is contemplated, because time is given in which to procure a suitable donor. We would particularly stress this simple procedure, which can be employed by any family practitioner in the humblest home. Blood transfusion should be proceeded with as soon as possible in cases in which hæmorrhage has been pronounced, but not in cases in which there has been little hæmorrhage. It is doubtful if blood transfusion is suitable for *pure shock* apart from hæmorrhage—*blood serum is much better.*

Raising the foot of the bed in such cases should be regarded as a temporary measure in cases of great gravity ; the patient has usually had a protracted labour ending in a difficult instrumental delivery, and the danger of infective material accumulating in the uterus is considerable. Quiet, warmth, electric cages, and transfusion of blood serum are the all-important details in combating shock. If, however, a large amount of blood has been lost, a transfusion of whole blood is indicated.

CHAPTER XXXIII

HÆMORRHAGES IN THE LATER MONTHS OF PREGNANCY OR DURING LABOUR

Placenta Prævia (Unavoidable. Hæmorrhage)—Hæmorrhage from a normally situated Placenta (Accidental Hæmorrhage)—Other Conditions associated with Hæmorrhage in the later months.

THE two all-important hæmorrhages of the later months of pregnancy are :—

- I. Placenta prævia—unavoidable hæmorrhage.
- II. Hæmorrhage from a normally situated placenta—accidental hæmorrhage or *ablatio placentæ*.

I. PLACENTA PRÆVIA—UNAVOIDABLE HÆMORRHAGE

By placenta prævia is meant the implantation of the placenta over the lower uterine segment (isthmus, p. 21), so that it completely covers the os internum—*central or complete*: reaches down to the

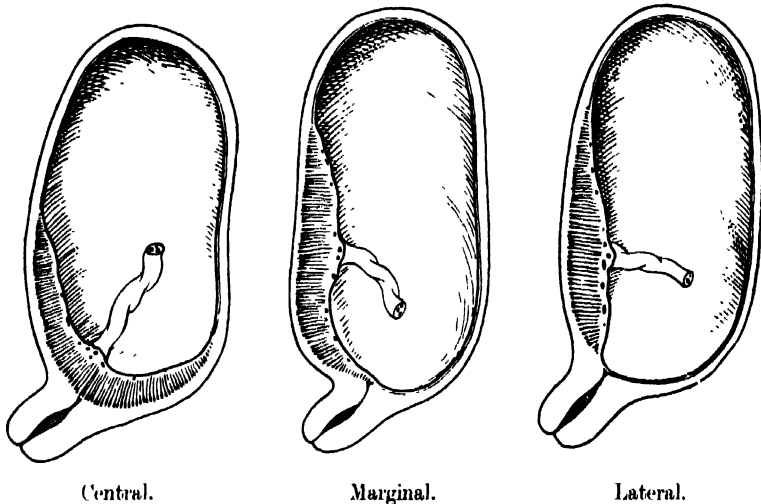


FIG. 235.—Varieties of Placenta Prævia

margin of the internal os—*partial or marginal*: or dips into the lower uterine segment—*lateral*. The illustrations explain these varieties (Fig. 235). In about 20 per cent. of cases the attachment is complete or central. The hæmorrhage which results from this low implantation

Occasionally, however, examples of shock occur where the parturition has not been severe and there has been no obvious cause for the occurrence. Such are probably examples of the *neurogenetic* as distinguished from the *traumatic* type of shock. Fear, dread of pain, or pronounced sensitiveness to pain tend to induce shock. It is of enormous advantage, therefore, if patients presenting such symptoms are given morphia and scopolamine during labour.

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Active Treatment.—Restoratives should be administered. Those usually given are digitalin, gr. $\frac{1}{100}$; strychnine, gr. $\frac{1}{10}$; and pituitrin, 1 c.c. The component of the latter extract—viz., *pitressin*—which raises blood-pressure, is particularly indicated. Intravenous saline with bicarbonate of soda to the volume of 1 pint with 10 per cent. glucose ought to be given at once ; this is an especially valuable procedure even if a blood transfusion is contemplated, because time is given in which to procure a suitable donor. We would particularly stress this simple procedure, which can be employed by any family practitioner in the humblest home. Blood transfusion should be proceeded with as soon as possible in cases in which hæmorrhage has been pronounced, but not in cases in which there has been little hæmorrhage. It is doubtful if blood transfusion is suitable for *pure shock* apart from hæmorrhage—*blood serum is much better.*

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- II. Hæmorrhage from a normally situated placenta—accidental hæmorrhage or *ablatio placenta*.

I. PLACENTA PRÆVIA—UNAVOIDABLE HÆMORRHAGE

By placenta prævia is meant the implantation of the placenta over the lower uterine segment (isthmus, p. 21), so that it completely covers the os internum—*central or complete*; reaches down to the

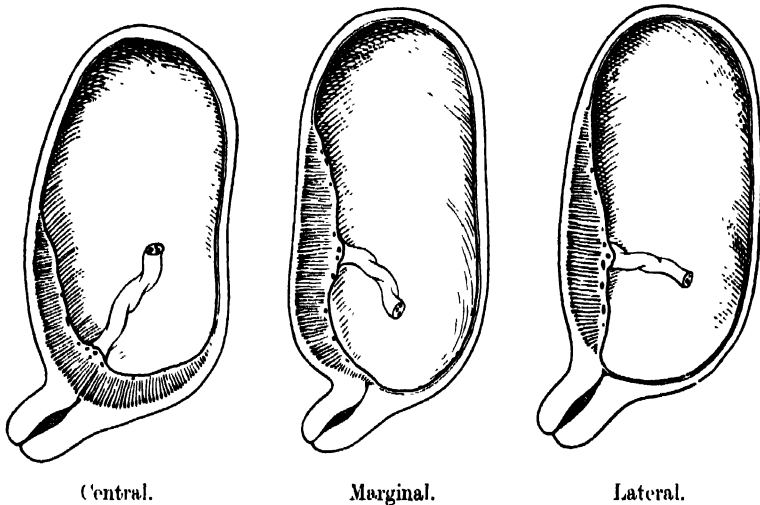


FIG. 235.—Varieties of Placenta Prævia

margin of the internal os—*partial or marginal*; or dips into the lower uterine segment—*lateral*. The illustrations explain these varieties (Fig. 235). In about 20 per cent. of cases the attachment is complete or central. The hæmorrhage which results from this low implantation

is designated "unavoidable hæmorrhage." The term was suggested by Rigby to distinguish it from the other form of antepartum hæmorrhage or "accidental hæmorrhage," which we shall consider later.

Ætiology.—Placenta prævia results from implantation of the zygote on, or in the immediate neighbourhood of, the isthmus in most instances. There is, however, another and very much rarer mode of origin in which, with a relatively low implantation of zygote in the corpus uteri, the decidua capsularis takes on placental formation, and the flap of placenta developed from it comes to extend into the isthmus and becomes attached to the mucosa of that area. This particular mode of origin was described by Hofmeier many years ago.

Several conditions favour the occurrence of placenta prævia. Large diffuse placental formation, such as occurs in placenta membranacea, favours it, although this abnormal development may be the *result* of the faulty implantation. It is more common in plural pregnancy. Chronic subinvolution is also commonly stated to be a predisposing factor—that the condition is more common in multigravidæ than in primigravidæ is cited in support of this contention. When, however, one recollects that somewhere about 18 per cent. of the examples of placenta prævia occur in primigravida, it will be realised that the factor of multiparity as a cause has been overstressed.

These remarks regarding the origin of placenta prævia do not take into consideration local conditions of endometrium, and/or the stage of trophoblastic development of zygote when it reaches the uterus. It is conceivable that under certain circumstances the fertilised ovum may not have attained a stage of development suitable for embedding until it reaches the lower pole or isthmus—in other words, gets caught up just as it is escaping. Or, on the other hand, there may be little folds of mucosa specially well developed for receipt of the zygote at the lower pole or even in the isthmus.

It is interesting to note that hæmorrhage, which is the most striking symptom of the condition, occurs, in the first instance, most commonly about the thirtieth week, when the lower uterine segment begins to develop (from the isthmus, as we have seen on p. 368). This development of the lower uterine segment undoubtedly disturbs a low placental attachment. In normal pregnancy, with the placenta in its ordinary situation, the lower pole of the gestation sac is relatively loosely attached to the isthmal area, thus giving free play to the gestation sac to expand undisturbed. In placenta prævia, on the other hand, the lower pole is anchored and development of the lower segment disturbs the placental attachment. In not a few instances, however, even of the most extreme examples of placenta prævia (central variety), hæmorrhage may be entirely absent until the last few days of pregnancy or until labour actually starts.

The hæmorrhage comes from the placental site ; very little comes from the placenta itself. Sometimes the bulk of the hæmorrhage comes from a single large sinus. Very occasionally severe bleeding (foetal) may result from rupture of the circular sinus of the placenta or from a vessel of a velamentous cord insertion—in such cases the child may bleed to death (p. 503).

In some cases of the central variety the placenta has been driven out in front of the child in the course of labour.

Symptoms.—Hæmorrhage, the outstanding symptom of placenta prævia, comes on very often quite suddenly, when the patient is at rest in bed. Generally the first hæmorrhage is slight—on the other hand, it may be profuse. At irregular intervals hæmorrhages recur of varying severity. In 30 to 40 per cent. of cases one or more “warning” hæmorrhages occur before the severe hæmorrhage. The tendency is for each recurring hæmorrhage to be more severe.

TABLE SHOWING ONSET OF FIRST HÆMORRHAGE IN A SERIES OF 279 CASES OF PLACENTA PRÆVIA IN WHICH DATE OF FIRST HÆMORRHAGE WAS NOTED (GLASGOW ROYAL MATERNITY HOSPITAL).

Weeks.	Totals.	Central.	Partial. ¹
20-25	3	..	3
26-30	18	3	15
30-35	99	18	81
36	42	10	32
37	24	3	21
38	23	6	17
39	18	2	16
40	52	10	42
Totals . . .	279	52	227

¹ This includes the *marginal* and *lateral* varieties.

Pain is not a symptom of placenta prævia, but when any blood-clot is retained in the cervix or vagina the patient may complain of a certain amount of uneasiness in the lower abdomen.

The general disturbances associated with this hæmorrhage depend upon the amount of blood lost and the extent to which the individual stands loss of blood. Where the hæmorrhage is profuse, pallor, small rapid pulse, cold clammy sweats, accelerated respiration, convulsions and even death may follow.

This is the ordinary course of placenta prævia, but probably many cases terminate as abortions in the early weeks of pregnancy (p. 322).

Diagnosis.—Placenta prævia is not difficult to diagnose if the finger can be passed through the cervix, and this is generally possible if there has been much bleeding and the patient is a multigravida. If, however, the bleeding has been slight or the patient is a primigravida the cervix is usually found so tightly closed that the finger cannot

be inserted into the cervical canal; therefore an early diagnosis is often difficult. We stress this point because the loose statement is often made that the finger can generally be passed through the cervix—there are, at the lowest computation, 30 per cent. of cases in which the cervix is closed at the time of the first bleeding.

Let us take first the cases in which the finger can be passed into the cervix and the lower pole of the uterus can be explored. Here the placenta can be readily felt, provided it is situated centrally or marginally. It may be difficult to feel, however, in the lateral variety, for the finger has to be pushed well into the cavity, and even then only the margin of the placenta may be within reach. Blood-clot from an accidental hæmorrhage is almost the only condition which can be mistaken for placental tissue. The former, however, is soft, smooth, and breaks up under pressure of the finger, while the placenta feels firm and rough. Cases of *hydatidiform mole* are encountered in which the ragged mass felt through the cervix very closely resembles placental tissue; but they come under notice early in pregnancy and present other features characteristic of the condition (p. 303). The roughened surface of an *intracervical carcinoma* or a *fibroid polypus* may also resemble the margin of the placenta.

There is, therefore, it will be observed, seldom any difficulty in the diagnosis of placenta prævia if the forefinger can be passed through the cervical canal. The greatest gentleness must be exercised in making this examination: it has happened many times that the digital exploration has started a brisk bleeding difficult to control. The family practitioner, in a case of hæmorrhage in pregnancy, should desist from making a vaginal examination and give instruction that the patient be transferred immediately to an institution. Time and time again there are admitted to hospital cases in which the sequence of events is as described—slight hæmorrhage, digital examination, severe hæmorrhage.

In cases in which the cervix is closed an exact diagnosis is not so simple: nevertheless, if all known methods of examination are employed it is generally possible to distinguish between placenta prævia and accidental hæmorrhage. On occasions one is able by abdominal palpation to locate a placenta situated low on the antero-lateral wall by noting that the presenting head can be easily defined on the one side, but only obscurely on the other—as if one were palpating through a doughy tissue. In the case of breech presentation it is more difficult because the breech is much softer.

Other features suggestive of placenta prævia are relatively high position of the presenting part, and greatest intensity of foetal heart sounds relatively high with the presentation cranial. Little, if any, importance should be attached to a uterine souffle low in the iliac fossa.

Turning now to the vaginal examination, fullness in one or both fornices, absence of ballottement, and difficulty in feeling the presenting

part are features occasionally noted, especially if the patient is a multigravida.

The presence of albuminuria and a high blood-pressure—valuable pointers to accidental hæmorrhage in many instances—do not preclude placenta prævia. Undue importance, therefore, should not be attached to the presence or absence of albuminuria and a heightened blood-pressure in the differential diagnosis of placenta prævia and accidental hæmorrhage (p. 585).

The more exact method of diagnosis by means of radiography is referred to in Chapter LX. It is there pointed out that by injecting certain substances into the amniotic cavity (amniography) a “filling defect” marking the placental site can be recognised. The objection

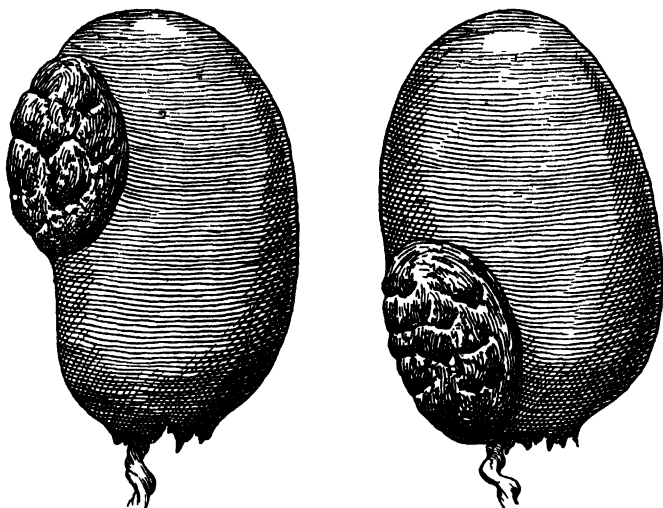


FIG. 236.—Rupture in Membranes relative to situation of Placenta. The right-hand figure illustrates where rupture in membranes would be in lateral placenta prævia.

raised to this method of examination is that the injected material is liable to bring on labour—but is this such a disaster under the circumstances?

There is a great future for “amniography” in cases of hæmorrhage in the later weeks, where an exact diagnosis is not possible by ordinary methods.

Before leaving the question of diagnosis there is another point worthy of mention. Examination of the placenta and membranes after delivery reveals in placenta prævia the hole in the bag of membranes in the immediate neighbourhood of the placenta; whereas in accidental hæmorrhage with a normally situated placenta, the hole in the membranes is some distance from the placenta (Fig. 236). Thus any doubt is removed as regards what the condition has been.

In concluding this section, we would impress upon our readers the

necessity of excluding any coexisting abnormality, such as pelvic disproportion, faulty position of foetus, malformation of child (4 to 5 per cent.). The point here is that the presence of any coexisting abnormality may influence the operator in deciding for or against a particular treatment.

Prognosis for Mother and Child.—Placenta prævia is responsible for somewhere about 5 per cent. of the total fatalities due to pregnancy, childbirth and the puerperal state (p. 756).

The causes of death are : (a) hæmorrhage ; (b) sepsis ; (c) shock, rupture of uterus, pulmonary embolism.

Causes of death are approximately as under :—

Hæmorrhage	55 to 60 per cent.
Sepsis	20 „ 30 „
Shock, rupture of uterus, embolism, etc.	10 „ 15 „

Obviously, therefore, it is of paramount importance that patients should be transferred to an institution prior to the severe hæmorrhage—admittedly impossible if the first hæmorrhage is extremely severe. Further, treatment should aim at reducing the chances of injury and infection to the minimum. The latter—viz., the risk of infection—must always be great and is extremely difficult to prevent because of the situation of the placental site. The others—severe injury to cervix and lower segment—can be prevented if forcible methods of extraction are not employed.

Apart from mortality, the *morbidity rate* is very high (30 to 50 per cent.) ; prolonged pyrexia, cellulitis, phlegmasia alba dolens, profound anæmia, and general debility are common sequelæ.

Still-births and neonatal deaths are and must always be high because of the relative frequency of prematurity and malnutrition. Furthermore, malformations of foetus are present in about 4 to 5 per cent. We shall refer to the foetal death-rates in connection with the different methods of treatment employed for this condition later (p. 756).

The prognosis for mother and child is influenced by the following factors—the factors which influence maternal and foetal mortality in all obstetric operations : (a) character of antenatal supervision ; (b) variety of placenta prævia ; (c) condition of patient when first seen ; (d) method of treatment employed ; (e) manner in which the treatment is carried out ; (f) place where treatment is carried out.

Treatment.—**PALLIATIVE TREATMENT.**—Before discussing active treatment a pronouncement is necessary regarding this very important question—is it advisable that pregnancy should be allowed to continue if placenta prævia is suspected ? In other words, is one justified in temporising with a case of placenta prævia ? One is only justified in doing so if the patient is placed in a hospital or nursing home, where skilled aid is available at any moment, as one never can tell when hæmorrhage may recur and how severe it may be. Even in an institution expectancy should

only be employed if the cervix is closed—never if the cervix is patent and the placenta can be felt.

ACTIVE TREATMENT.—Every patient suffering from antepartum hæmorrhage should be immediately placed in an institution if this is possible, and her condition does not contraindicate her removal. In populous areas institutional accommodation is at hand, but in outlying country districts the risks of transport may outweigh the risks of domiciliary treatment (*vide* Footnote, p. 556).

Opinion regarding the treatment of placenta prævia has changed

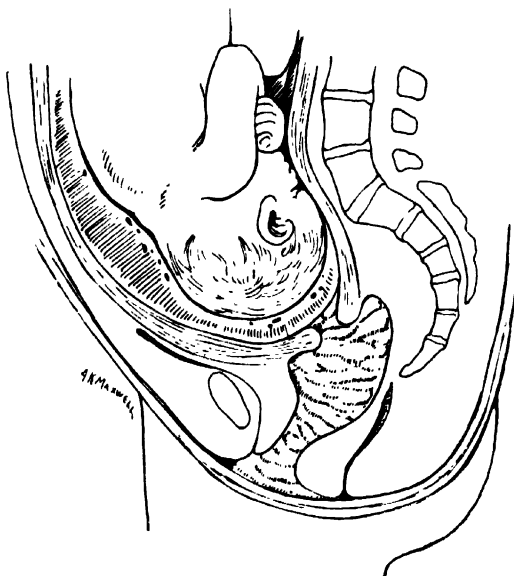


FIG. 237.—Vaginal Plug in Placenta Prævia. The gauze has been pressed into cervix against placenta, and the fornices and vaginal canal have been tightly packed.

greatly in recent years. No longer has Cæsarean section to be justified, it has come to be accepted as the treatment of choice for grave cases. Let us discuss in the first instance the alternative treatments which may be employed in a large number of instances in which Cæsarean section is not necessary.

These alternative treatments include the following: (1) vaginal plug or tamponade; (2) rupture of membranes; (3) rupture of membranes and employment of Willett's forceps; (4) bipolar version; (5) metreurynter.

Vaginal Plug or Tampon.—The great objection to this method of treatment is the danger of conveying infection to the lower part of the uterus, as, in placenta prævia, the widely dilated vessels, the repeated hæmorrhages and the presence of blood-clot render it

peculiarly susceptible to infection. Statistics show that where vagina-plugging has been employed, somewhere about 30 per cent. of cases develop infection, as indicated by pyrexia in the puerperium. Generally it is of a minor degree, but not infrequently it is grave and proves fatal. In great part it can be prevented by thorough preparation and disinfection of vulva and vagina prior to plugging—this is feasible in an institution but extremely difficult in domiciliary practice.

To carry it out satisfactorily the patient should be anæsthetised, brought to the edge of the bed, and placed in the lithotomy position. The pubes should be shaved and the external genitalia and vagina thoroughly disinfected. After such preparations the vaginal wall should be retracted with a vaginal retractor, and gauze (preferably) or pledgets of cotton-wool carried up into the cervix and tightly packed into the fornices and vagina (Fig. 237). To place the gauze into the cervix the operator should steady the cervix by exerting slight traction on it with a volsella.

Ineffective packing is worse than useless—it in no way controls the bleeding and adds to the risk of infection. On the other hand, thorough packing, as described, completely controls the bleeding. The membranes should not be ruptured before packing—the placenta and membranes at its edge are very tough and are an excellent *point d'appui* for the packing. Packing is seldom advisable in lateral placenta prævia and very seldom indeed necessary in the marginal variety—rupture of membranes or version depending on circumstances are the procedures which should be followed.

The general practitioner in an outlying part of the country may on occasions have no alternative but to pack the vagina—*e.g.* if blood is pouring from the vagina, if the cervix is only slightly dilated (if sufficiently dilated he should perform external version and bring down a foot), and if the patient has had a previous hæmorrhage. On the other hand, if the cervix is closed and this is the first hæmorrhage, he need not pack, because the hæmorrhage will cease almost certainly—he should administer to her small doses of morphia, keep her in bed for a few days and then have her transferred to hospital.

Almost never is it necessary or advisable to pack a patient in hospital. If she is admitted in a collapsed condition from loss of blood she should be kept at absolute rest and a blood transfusion given. When she has recovered she should be anæsthetised with gas and oxygen and prepared for either abdominal (Cæsarean section) or vaginal delivery—then she should be examined and a decision made as regards the best procedure in the circumstances.

Rupture of Membranes.—This simple procedure should be employed in the *lateral variety*. It may also be employed in the *marginal variety* provided only a small margin of placenta projects over the os uteri. A sharp-pointed instrument should be employed; because, the membranes being tough at the margin of the placenta, a blunt-pointed

instrument might dislodge more of the placenta. After the membranes are punctured it is advisable to gently push up the presenting part a little and so allow a good quantity of liquor amnii to escape. As a result the presenting part comes well down on to the placenta. An abdominal binder extending above the fundus should be applied, but not too tightly at first. Should the bleeding not be completely arrested, *Willett's forceps* (Fig. 238) should be employed. The forceps is passed through the os and the scalp of the child's head grasped. A roll of gauze or a bandage is passed through the handles of the instrument, the ends brought over the foot of the bed and a weight of one to two pounds attached to the gauze. This maintains the head pressed against the placenta. If the breech is the presenting part a foot should be brought down provided it can be done easily.

Rupture of membranes gives most satisfactory results as regards the mother, but it is associated with a foetal mortality rate of 20 to

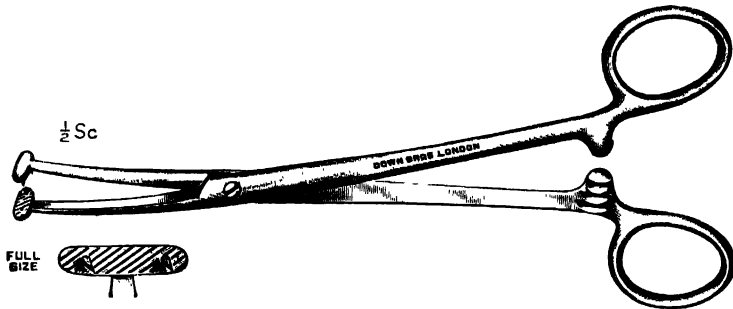


FIG. 238.—Willett's Forceps.

30 per cent.—the rate is slightly higher if Willett's forceps is employed ; and it is higher if a foot is brought down in a breech presentation.

Version.—The procedure was recommended by Ambroise Paré nearly three hundred years ago and was universally employed by obstetricians before Cæsarean section came into favour. *It still is the sheet-anchor of the general practitioner faced with a grave case of placenta prævia.* With the child's leg pulled down and its buttock pressing on the placenta (Fig. 239) the hæmorrhage is completely under control. We would strongly recommend *external* (p. 695) rather than *internal* version, because if the former is chosen the placental site is not disturbed and the risks of infection are diminished. These external manipulations are generally successful, because in most instances pregnancy has not yet reached term, and the child being small, and the presenting part not engaged, it can be readily turned. Besides, the placenta situated in the lower part of the uterus makes the uterus more globular. Having turned the child by external version, the foot can be brought down through or alongside the placenta and through the cervix easily, even where the cervix is only slightly dilated. Here, again, the placenta or membranes should be ruptured by a

sharp instrument—not by the fingers, which might detach more placenta. Often the foot comes down itself when the membranes are ruptured and can be grasped with two fingers, or with volsella. *The great object is to disturb the placental attachment as little as possible.*

After version it is very important that the delivery should not be hastened. Many children are lost by indiscriminate traction on the limb and hastening the delivery through the imperfectly dilated cervix. Furthermore, one must bear in mind that the cervix and lower segment are very easily torn in the circumstances.

Taking large series of cases the results from this treatment are approximately 4 to 8 per cent. maternal mortality and 60 to 70 per cent. foetal mortality. If the greatest possible care is taken and the

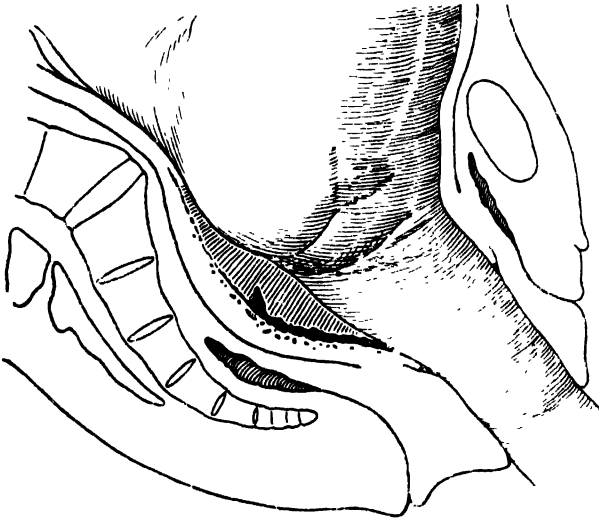


FIG. 239.—Showing how Thigh of Child compresses Placenta.

delivery of the child not unduly hastened by dragging on its limbs, maternal mortality can be reduced to 2 to 4 per cent. : but the foetal mortality is and will always be high—never below 50 to 60 per cent. It is for this reason, viz., the high foetal death-rate, that so many obstetricians have turned to Cæsarean section in recent years.

Metreurynter.—On page opposite is shown the metreurynter (Cham-petier de Ribes' bag) inserted and compressing the placenta. The advantage claimed for this method of treatment is that it lessens foetal mortality. If employed, the membranes must be ruptured before the metreurynter is inserted (p. 742). When the bag has been forced out of the cervix the os is fully dilated. If the head presents, forceps should be applied and the child extracted ; and if the presenting part is a breech, a limb should be brought down. It is not a method of treatment favoured in this country, but it is employed in some clinics of the Continent and the United States of America.

Cæsarean Section.—In recent years the much more radical procedure of Cæsarean section has been advocated—largely on the grounds that with this operation the maternal mortality is not increased, indeed is slightly lessened, and the foetal mortality is small (6 to 10 per cent.).

The opponents of Cæsarean section bring forward the arguments that excellent results are secured if the ordinary methods are employed by experienced obstetricians operating under favourable conditions; that the operation is not suited to domestic practice; that it is too radical an operation for the condition. *As regards the first*, we admit that good results may be secured by ordinary methods in respect to

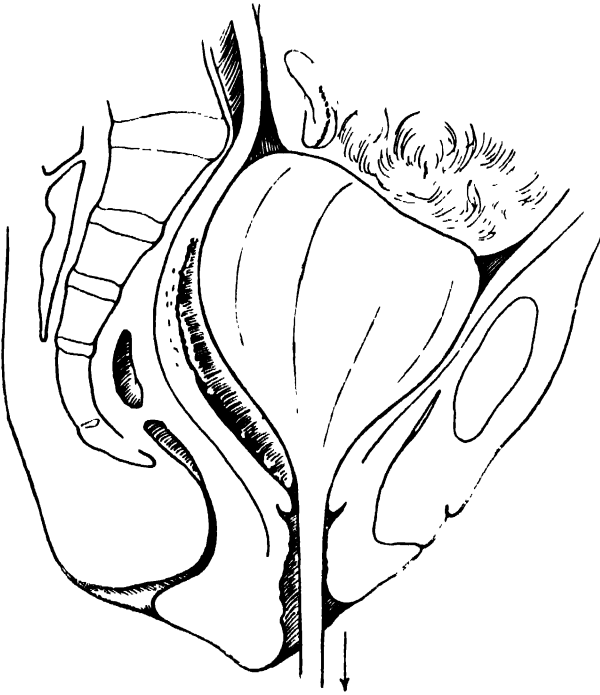


FIG. 240.—Metreurynter in Placenta Prævia.

the mother, but not in respect to the child. *As regards the second*, we believe that this and many other obstetrical complications *should not be dealt with as in the past in the patient's own home*, but should be treated in a nursing home or hospital. No individual with acute appendicitis is treated in his or her own home unless in very special circumstances. Why should it be otherwise with this grave complication? Lastly, *as regards the third argument*—that the operation is too radical for this condition—we have now figures of astounding excellence for Cæsarean section in this and other countries. Long series (100 to 150 cases) without a single maternal death and, furthermore, by no other method can one secure so low a foetal death rate as by Cæsarean section (*vide p. 730*).

Blood or saline transfusion and Cæsarean section have altered the outlook in this most grave complication. Cæsarean section is now the operation of choice for central placenta prævia, just as simple rupture of membranes is the operation of choice in the lateral variety; while for the marginal type sometimes the former sometimes the latter treatment should be selected.

Special Complications associated with Placenta Prævia.—We would mention first retention of the placenta. In all except the lateral variety the placenta is liable to be retained, partly because of uterine inertia but also because part of it is so often adherent. Manual removal is therefore necessary in many instances, which obviously in the circumstances adds to the danger of infection and shock. Again, the local and general condition of the patient favours postpartum hæmorrhage, which in the circumstances is very difficult to control. In a fair number of patients this postpartum hæmorrhage is the last straw in causing death—hence the importance of blood transfusion. Mention must also be made of two later complications in the puerperium, viz., phlebitis and persistent anæmia. Neither can be said to be preventable, although both are less likely to occur if the delivery is well managed and a blood transfusion is administered.

Anæmia if it persists should be treated by suitable diet and tonics containing iron and arsenic. Convalescence is always slow and should not be hurried unduly.

II. HÆMORRHAGE FROM A NORMALLY SITUATED PLACENTA — ACCIDENTAL HÆMORRHAGE OR ABLATIO PLACENTÆ

By accidental hæmorrhage is meant hæmorrhage occurring in the later weeks of pregnancy, from partial or complete detachment of a placenta situated above the level of the lower zone of uterus. The name “accidental hæmorrhage” was given to this complication by Rigby to distinguish it from “unavoidable hæmorrhage,” the hæmorrhage from placenta prævia which we have already considered.

There are doubtless certain objections to these terms, especially “accidental hæmorrhage,” for it might be understood as implying hæmorrhage the result of an accident. A number of American authors use the term *ablatio placentæ* for the condition, a term suggested by Holmes, of Chicago. It has never come into general use in this country, although much can be said for it (*e.g.* *ablatio retinæ*).

Ætiology.—Accidental hæmorrhage is relatively rare in primigravida. Its ætiology is still not quite fully understood, although such conditions as chronic inflammation of the uterus (metritis and endometritis), fright, injuries and diseases of the various systems (nervous, digestive and otherwise) favour its occurrence. In certain cases, then, the ætiology of this complication is similar to that of abortion.

In more recent years a number of writers have drawn attention to the fact that associated with this condition there are very frequently hæmorrhages into the wall of the uterus, albuminuria, and a raised blood-pressure. The view has therefore gradually come to be accepted that the condition is toxæmic. The hæmorrhages into the uterine wall and placental site have been compared to those found in the kidney, liver and other organs in cases of toxæmia.

If a uterus, removed post-mortem or during life by hysterectomy for concealed accidental hæmorrhage, is examined it will be found that the muscle is extensively injured by large extravasations of blood which have separated and torn the muscle fibres. Such injuries are specially marked at the placental site. They affect the whole thickness of the wall, but are most pronounced underneath the peritoneum. In some instances the peritoneal surface has given way, a free bleeding has occurred into the peritoneal cavity. Rupture of the uterus has also occurred in a few instances. Couvelaire termed the condition "uterine apoplexy." There has been much discussion in recent years as to whether the hæmorrhages and necroses found are evidence of toxæmia and comparable to the hæmorrhages occurring in pre-eclamptic toxæmia or are the result of hypertension induced by the toxæmia. In point of fact, either may cause accidental hæmorrhage.

Possibly the toxæmic theory has been pushed too far, because in not a few cases (20 per cent. possibly) albumin is not found in the urine and the patient does not show any other signs of toxæmia. Probably, therefore, while the great majority of cases result from toxæmia, a number of the minor examples of the complication are caused by the other disturbances already mentioned. In the "concealed" variety, the worst type, a large proportion of cases suffer from chronic nephritis and practically all from some grave form of toxæmia.

In a few instances an injury has been the cause of placental detachment—*e.g.* fall or blow. The most striking example of injury as a cause is when the placenta becomes detached as a result of external version—*e.g.* conversion of breech into vertex position (p. 464). Detachment from traction on a short cord has been recorded—it must be an accident of the very greatest rarity.

Varieties and Symptomatology.—Accidental hæmorrhage is most commonly a complication of the last quarter of pregnancy. As witnessed clinically it may be divided into three varieties (Fig. 241): (1) apparent; (2) concealed; (3) partially concealed and apparent (mixed); and as each form is associated with variations in the symptoms we shall consider each separately.

(1) *Apparent.*—In this variety blood comes away freely and is discharged from the cervix and vagina. Hæmorrhage may come on quite suddenly or after some straining effort. The blood discharged may be bright red or, if retained in the lower part of the uterus, clotted and dark in colour. In many instances the first hæmorrhage is

comparatively slight, and recurrent bleedings occur, as in placenta prævia. At other times, and generally if bleeding is very severe, labour soon follows the first hæmorrhage. Associated with the hæmorrhage, if it is severe, are faintness, sickness, evidences of anæmia, such as pallor, rapid pulse, etc.

On examining the abdomen in this variety the uterus appears little altered in size, consistency or sensitiveness. On vaginal examination, if the os is dilated, the blood may be recognised issuing from the cervix, and blood-clot can be felt in the lower part of the uterine cavity—the condition, therefore, has to be distinguished from placenta prævia; but this, as already described, is not difficult.

(2) *Concealed*.—Undoubtedly examples of this variety are with few exceptions toxæmic in origin. Albuminuria and a high blood-pressure

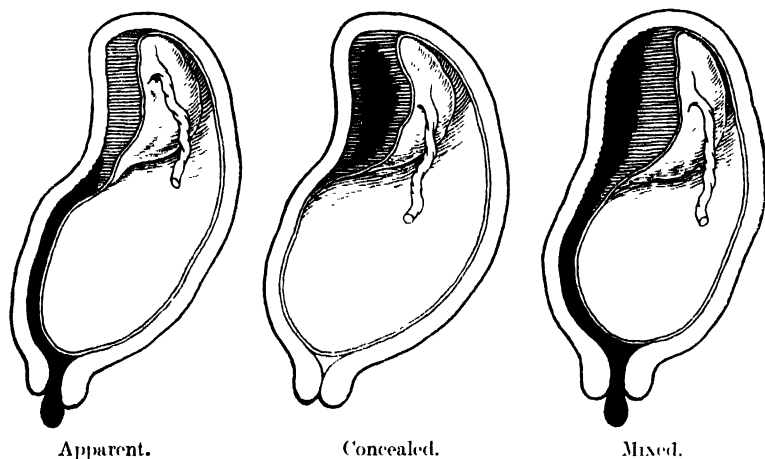


FIG. 241.—Varieties of Accidental Hemorrhage.

(chronic nephritis) are generally present. Blood and blood-clot become pent up between placenta and uterine wall and practically none escapes from the uterus, although there may be sometimes a discharge of pale serosanguineous fluid. Here the patient is much more distressed, and is generally restless and may be collapsed. She may state that she "felt something giving way," and she generally complains of severe pain over the uterus and as if that organ was "going to burst." If the uterus is palpated it will be found to be distended and tender and more globular in shape. These are the characteristic features of concealed accidental hæmorrhage.

On vaginal examination probably nothing can be felt, for the cervix is generally closed. This retained blood and blood-clot is pent up chiefly behind the placenta, although a certain proportion passes down between the membranes and uterine wall.

The retroplacental bleeding and overdistension induce, naturally, symptoms characteristic of hæmorrhage and shock, such as pallor,

faintness, small rapid pulse. The body may be suffused with a cold, clammy sweat. *The collapse is out of all proportion to the loss of blood.* It results from shock owing to undue uterine distension and the intramural hæmorrhages already referred to. The condition is most serious. It is always associated with the death of the child and, in a large proportion of cases, with the death of the mother.

(3) *Mixed*.—As shown in the illustration (Fig. 241), the third form is where a certain amount of clot is retained behind the placenta and membranes but a portion comes away as free hæmorrhage. The student may think at first that this subdivision is unnecessary; but it is extremely important that it should be presented as a separate variety



FIG. 242.—Showing detached portion (crater-like area). Older infarctions (case of chronic renal disease).

because the condition may not be looked upon as serious and the relative gravity of it may be judged by the blood escaping from the vagina. *Now, the seriousness is in proportion to the degree of abdominal pain and collapse, not in proportion to the amount of blood lost.* This is a matter of great importance. With this variety of accidental hæmorrhage there is a certain degree of uterine tenderness, sometimes located to a particular area, a moderate degree of distress and a rapid pulse. But it must be clearly understood that these symptoms vary greatly in degree.

By examining the placenta and membranes after delivery, any doubt is removed as regards what the condition has been. The cotyledons are flattened and in the concealed variety there may be a crater-like depression (Fig. 242) on the maternal surface produced by the retroplacental hæmatoma.

Prognosis.—The prognosis is very grave in the concealed variety; foetal mortality is 100 per cent. and maternal mortality may be 30 to 50 per cent. In the mixed form foetal mortality is still very high, but maternal mortality is much lower; while in the external variety foetal mortality is still 40 to 50 per cent., maternal mortality should not exceed 2 to 3 per cent. The prognosis is influenced very much by the treatment employed and the experience and skill of the medical attendant.

Treatment.—As regards treatment, there is one essential point of difference between accidental hæmorrhage and placenta prævia. *The outlook as regards the child in accidental hæmorrhage is hopeless in the worst cases; consequently the mother alone deserves consideration.* The life of the foetus is really negligible except in the very slight cases of the external variety. We have seen that this is quite otherwise with placenta prævia, where, if the most radical treatment of Cæsarean section is selected, very few children are lost, even in the gravest variety (central).

Apparent Variety.—The treatment to be employed in this variety depends whether or not there are active uterine contractions. If there are active uterine contractions the simplest and best treatment is to *rupture the membranes*. Nothing else is necessary: the labour will progress without further hæmorrhage, and occasionally, if the placental detachment has been slight, a living child will be secured.

If there is no attempt at uterine activity, a treatment very often recommended is to plug the cervix and vagina very tightly, as shown in the illustration (p. 579). This having been done in the manner already described, a firm pad should be placed over the vulva and attached to the binder which is firmly applied round the abdomen. The rationale of this treatment, which is often referred to as the Dublin or Rotunda treatment, is that the plug dams back the blood, exercises direct pressure on the uterine vessels and stimulates uterine contractions. The packing is removed in thirty-six hours, or earlier if there are indications that labour is progressing. We have always been opposed to this treatment—we understand that it has been abandoned recently in the Rotunda Hospital. Rupture of the membranes and the administration of pituitary extract and morphia is the simplest and best treatment.

Mixed.—Here a similar treatment should be pursued—rupture of membranes and injections of pituitary extract ($\frac{1}{2}$ c.c.) combined with morphia ($\frac{1}{4}$ grain) at intervals of two hours.

Concealed.—This variety, as we have already seen, is so very serious that many recommend Cæsarean section, followed by hysterectomy. (Some think that hysterectomy is unnecessary, that the uterus should be conserved and the wound stitched in the ordinary manner (p. 724).) Undoubtedly by this procedure a considerable number of women can

be rescued, and until quite recently it was favoured as being the safest procedure.

In recent years, however, most obstetricians have come to favour a much less radical procedure the purpose of which is to combat the shock from which the patient is suffering. With this object in view she is kept absolutely at rest in bed, soothed down by morphia, with or without hyoscin, and pituitary extract is administered. This method of treatment has been extensively employed, and has given satisfactory results in a large number of cases, but it has its limitations. *There will always remain a few cases which should be treated by abdominal section.*

Alternative Treatments.—Other procedures have been suggested, such as version after rupturing the membranes, the use of the met-reurynter (p. 742) and accouchement forcé (p. 741). We have not found that either of these treatments is better than the procedures described. We agree with all obstetricians of to-day that accouchement forcé and forcibly dilating the cervix is most dangerous. And the reason why it is so dangerous is because if a patient is extremely collapsed, forcibly stretching the cervix adds very markedly to the shock.

In some cases a transfusion of blood or normal saline may save the patient's life. Many of the fatalities are due not to the loss of blood but to shock and/or to the disease which is the cause of the complication. For example, occasional deaths are due to cerebral hæmorrhage, "cortical necrosis of kidney" (p. 237), etc.

OTHER CONDITIONS ASSOCIATED WITH HÆMORRHAGE IN THE LATER MONTHS

(1) CARCINOMA OF THE CERVIX.—Hæmorrhage from carcinoma may very closely resemble slight accidental hæmorrhage, especially if the carcinoma is intracervical.

The condition has been already referred to in connection with tumours complicating pregnancy (p. 295). In so far as it complicates labour it is discussed under dystocia (p. 541).

(2) FIBROMYOMATA OF THE UTERUS.—Such tumours have been already considered (pp. 294, 549). Uterine hæmorrhage where such tumours exist is relatively infrequent.

(3) POLYPUS OF THE CERVIX.—Hæmorrhage resulting from either a fibroid or mucous polypus is seldom of serious consequence. The condition is very easily recognised as the tumour can be felt projecting through the cervical canal.

(4) ULCERATION OF THE CERVIX (NON-MALIGNANT).—The hæmorrhage associated with this condition is extremely slight. Should there be any uncertainty regarding the nature of the ulceration a small

portion of tissue should be removed from the cervix and examined microscopically.

(5) EXTRAUTERINE PREGNANCY.—Hæmorrhage from an extra-uterine pregnancy in the later months is very infrequent, although there may be some uterine hæmorrhage just about full term, when a spurious labour often occurs. The condition is fully considered elsewhere (p. 355).

CHAPTER XXXIV

INJURIES TO THE BIRTH CANAL AND OTHER ACCIDENTS TO THE MOTHER

Injuries to the Bony Pelvis—Injuries to the Soft Parts—Laceration of Vulva, Vagina and Perineum — Rupture of Uterus — Fistulæ — Emphysema — Hæmatoma of Vulva—Retroperitoneal Hæmatoma—Hæmatoma of Rectus Abdominis Muscle.

THE graver injuries to be described in this chapter are generally inflicted during a difficult and instrumental delivery ; but many of the minor ones and very occasionally even those of a graver nature may occur in a parturition which terminates spontaneously. We shall consider them under two headings : (a) injuries to the bony pelvis ; (b) injuries to the soft parts.

(a) INJURIES TO THE BONY PELVIS

Rupture of Symphysis Pubis.—Reference has been already made to the softening and relaxation which occur in the pelvic joints as a result of pregnancy (p. 121). It is not surprising, therefore, that rupture of the symphysis pubis should occasionally occur. The rupture may happen during a spontaneous delivery ; but generally it takes place during the forcible extraction of the child from the pelvis. In the former event the patient is generally aware of something giving way. The accident is not serious, although the patient may complain of pain over the symphysis pubis, and tenderness when the bones are pressed upon. Where the accident happens during forcible extraction of the child serious injury may be done to the soft parts, more especially the urethra.

A firm binder round the pelvis is generally all the treatment that is necessary. Should the patient suffer much pain it is advisable to apply two broad strips of adhesive plaster round the whole pelvis ; this keeps the joint immobile, while it gives the patient a feeling of comfort and support.

Fracture and Dislocation of the Coccyx.—This accident may also occur in a spontaneous delivery, but more often it happens during the artificial extraction of the child. It is seldom recognised at the time of delivery ; nor does the patient suffer much immediate discomfort from it. Generally the injury comes under one's notice

some months after the parturition, when the patient returns complaining of pain in the lower part of the sacrum, and especially on rising or sitting down. Occasionally also pain is felt during defæcation, as the levatores ani muscles come specially into action.

The condition is readily recognised by palpating the coccyx with two fingers in the vagina and the thumb over the bone externally. Generally the bone is discovered to be acutely bent forwards; only very occasionally is it displaced backwards. It is always tender when manipulated.

In some instances, although no fracture or dislocation is discoverable, discomfort and neuralgia settles in this area, termed "coccydynia" or "coxalgia"—due probably to injury to the sacrococcygeal joint. Occasionally this condition is the result of a fall or blow.

The treatment which gives complete relief is to remove the coccyx; and this is very easily carried out by making a longitudinal incision over the lower part of the sacrum and coccyx and removing the latter with bone forceps.

(b) INJURIES TO THE SOFT PARTS

It is very rarely that the primiparous woman escapes altogether from injury to her birth canal. Generally speaking, the injuries are slight, and are limited to tears of the vulva or vaginal orifice. Nevertheless each wound is a potential focus of infection. Consequently the nurse in charge must give great attention to the toilet of the vulva, more especially in the early days of the puerperium. We would stress the necessity for careful inspection of vulva and vaginal outlet after delivery, and the importance of stitching even slight tears of the perineum.

For convenience' sake we shall consider the injuries in the following order :—

- (a) Injuries to the vulva.
- (b) Injuries to the vagina and perineum.
- (c) Laceration of the cervix.
- (d) Rupture of the uterus.
- (e) Injuries to bladder, ureter, rectum, and resulting fistulæ.
- (f) Other rarer injuries.

(a) **Injuries to the Vulva.**—If the vulva is carefully examined after a parturition, slight tears of the labia minora, the fourchette, and sometimes the vestibule, can be detected. In most instances they escape notice unless search is made for them.

For slight lacerations in this area frequent washing with antiseptics has to be relied on. Dabbing the wounds with tincture of iodine (4 per cent.) or Dettol (5 per cent.) morning and evening is useful. Suturing of slight wounds is not necessary. In some instances,

more especially where the laceration occurs in the vestibule, very severe hæmorrhage may result which is difficult to control. Indeed, we have occasionally found that the simple introduction of coapting sutures is not sufficient, and that in the case of tears of the vestibule a purse-string suture is necessary before bleeding can be controlled.

If a labium is lacerated, the edges of the wounds should be coapted accurately and carefully stitched.

(b) **Injuries to the Vagina and Perineum.**—Lacerations of the perineum are the commonest injuries to the birth canal. In practically all primiparæ there is tearing of the fourchette, and in many laceration of the perineal body.

Three degrees of laceration are generally described : (1) where only a slight tear in the perineum occurs ; (2) where the laceration reaches

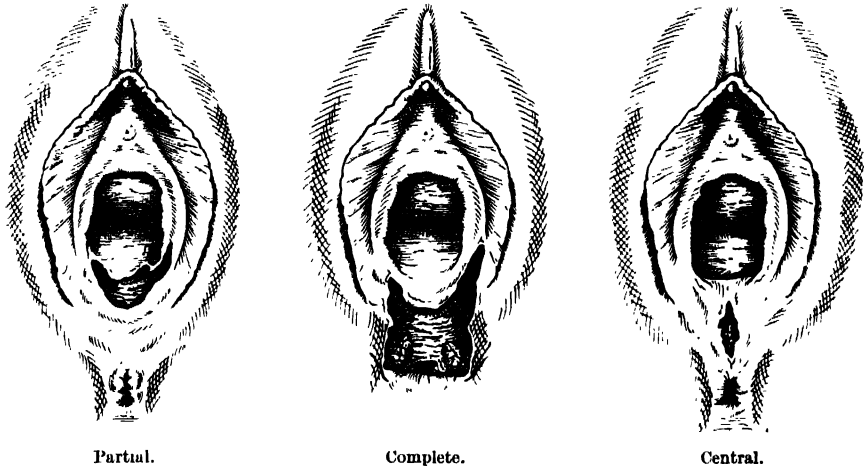


FIG. 243.—Lacerations of Perineum.

up to the margin of the anus ; (3) complete laceration, where the tear extends into the rectum. There occurs occasionally (4) a central perineal rupture where the presenting part is driven through the perineal body (Fig. 243).

Lacerations of the perineum are favoured by a large head, mal-position of the head, more especially the persistent occipito-posterior position, early operative interference where the child is dragged down on to the unstretched perineum and extracted too rapidly. For details regarding prevention of perineal laceration see page 406.

(1) *Lacerations of the First Degree with only a Slight Tear of the Perineum.*—Although generally situated in the middle line, they are frequently more pronounced on one side. In all instances the laceration should be repaired, as a prevention to infection and to preserve the sphincter of the vagina. One, or at most two, sutures of catgut, or, better, silkworm gut, should be inserted and the torn edges carefully

coapted. The advantage of catgut is that the stitches do not require to be removed, but in this area, which is impossible to keep surgically clean, *silkworm sutures are preferable*. The stitching may be done during the third stage while the placenta is separating and the patient is still under the influence of the anæsthetic.

(2) *Laceration of the Second Degree where the Tear reaches to the Margin of the Anus.*—Lacerations of this variety vary in extent and in the degree to which the vaginal wall is implicated. In the slighter forms only the perineal body suffers, but where the tear is more extensive it will generally be found that the laceration extends up the posterior vaginal wall in a lateral direction. Indeed, in most instances the vaginal laceration is seen to be bilateral, running up both sides of the posterior column of the vagina to a varying extent (Fig. 243). In lacerations of this variety and extent the perineal tear should never be overlooked, as it is so obvious if the parts are inspected even casually; but the vaginal tear may quite readily be missed if not searched for. Now, it is very important in the repair of this injury that the edges of the vaginal wounds should be as carefully coapted as the wound in the perineal body. If only the perineum is repaired ragged pockets are left in the vagina and in the levator ani muscles, in which blood and lochia collect and this interferes with the satisfactory union of the torn levatores ani muscles. The result is that sooner or later the patient suffers from relaxation of the tissues of the pelvic floor and a progressive prolapse of the vaginal walls develops.

We do not advise repairing lacerations, of the nature and extent described, during the third stage. After the child is born and the uterus is well retracted the patient should be placed in the lithotomy position with her pelvis at the edge of the bed or end of the table. The parts around the vagina should be carefully cleansed and a large piece of gauze soaked in an antiseptic should be inserted into the vagina to keep the blood from getting in the operator's way and obscuring his view of the wound. (He must not forget to remove the gauze on the completion of the operation.) If a local anæsthetic is administered it may not be necessary to give the patient any general anæsthetic.

In the accompanying illustration (Fig. 244) the manner in which the vaginal and perineal stitches should be inserted is shown. It will be observed that the operator carefully coapts the edges of the vaginal wound with catgut, and having done this and knotted the sutures in the vagina he introduces silkworm gut for the perineum. Many operators prefer to employ a continuous catgut suture for the vaginal wounds. The wound should then be "dabbed" with tincture of iodine and a dressing applied.

(3) *Complete Laceration where the Tear extends into the Rectum.*—Lacerations of this extent should rarely occur. They are almost inexcusable, except in the case of an extremely difficult delivery. The extent of the rectal tear may vary. Sometimes it hardly involves

the sphincter; in other cases the whole sphincter is torn, and the laceration extends well up the rectal wall.

In repairing this variety of laceration the tissues must be coapted most accurately if a good result is to be secured. First the tear in the bowel should be repaired. The sutures employed for this purpose should be of fine chromic catgut, and they are inserted in the following manner. The point of the needle is passed from the rectal surface, through the torn tissue, across and into the torn tissue of the other side, the point of the needle being finally brought out into the rectum again (Fig. 245 (1)). *When such a suture is tied, it is obvious that the knot will be inside the rectum.* The number of rectal stitches depends upon the extent of the tear. Having repaired the laceration

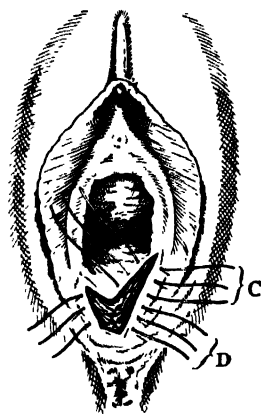


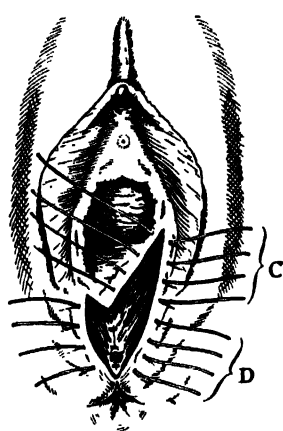
FIG. 244.—Repair of Incomplete Tear.

C. Vaginal Stitches (catgut).
D. Perineal Stitches (silkworm).



FIG. 245.—Repair of Complete Tear.

A. Rectal Stitches.
B. Stitch to coapt Sphincter.



C. Vaginal Stitches (catgut).
D. Perineal Stitches (silkworm)

of the bowel in the manner described, the next suture (a very important one) should be inserted with the object of coapting the torn edges of the sphincter. It should be of ordinary catgut, the knot being left buried in the perineal body. The vaginal sutures (Fig. 245 (2)) are then inserted in the manner already described for lacerations of the second degree. Lastly, the perineal sutures are inserted, and these should be of silkworm gut; the manner of inserting them has been described already.

The results secured from careful stitching of the perineum are generally very satisfactory, *but only if the nurse keeps the parts absolutely clean.* This is not always easy, as the septic rectum is in the immediate vicinity of the wound. The wound must be frequently swabbed with antiseptic solution. After the nurse has sponged the perineum she should dry it very thoroughly and dab the wound with iodine. A small dressing of gauze should then be applied. It is generally

better to postpone the first evacuation of the bowels until the fourth day. After that an evacuation every other day should be arranged. The silkworm stitches should be removed on the eighth day. Generally speaking it will be found of advantage to give a vaginal douche night and morning so as to prevent any lochia lodging around the vaginal stitches. The nurse should be cautioned against passing the nozzle high into the vaginal canal. As an alternative the nurse may separate the labia very gently and pour from a jug some antiseptic solution into the vagina.

While the silkworm stitches are in position the patient may be allowed considerable freedom of movement, but after they are removed she must be careful for a day or two in case the wound may give way.

Not infrequently there is retention of urine for a day or two. If the ordinary means (p. 636) employed do not prove effective it is necessary to pass a catheter, with every precaution, of course, taken to prevent infection of the bladder.

(4) *Central Perineal Rupture*.—It occasionally happens that the child is driven through the perineal body whilst the anterior and posterior portions remain intact. This is known as “central” laceration of the perineum. It usually occurs in a precipitate labour where the forces are very strong and the child’s head is driven down on to a soft and sagging perineum (p. 539).

If *on inspection the rectum is uninjured* the raw edges should be brought together with silkworm gut inserted through the whole thickness of the perineum. If, *however, the tear has extended posteriorly into the rectum*, as is frequently the case, it will generally be found advisable to divide the bridge between the laceration and vagina, and treat the condition as a complete perineal tear. To attempt to repair it without dividing the bridge in front is seldom satisfactory, as it is almost impossible to coapt exactly the rectal wound unless this is done.

(c) **Laceration of the Cervix**.—The cervix is almost invariably torn to some slight extent at the first parturition, *and most commonly the tear is on the left side*, because the occiput is so frequently directed towards that side. These slight lacerations heal satisfactorily, although they always produce a slight alteration in the shape of the external os, and from this one can generally decide whether a woman has borne a child or not.

In some instances the tearing is more extensive, even where the delivery is spontaneous, but extensive lacerations from spontaneous delivery are very rare indeed. Almost invariably, such lacerations result from dragging the child through the incompletely dilated cervix with forceps or by some other means. In some few instances this rapid delivery may be necessary in the interests of the mother or child, but generally it is quite unnecessary. We have repeatedly

pointed out in this work how undesirable it is to extract the child forcibly through the cervix before it is fully dilatated. The more severe lacerations may extend to the vaginal vault and even into the lower uterine segment and lower part of the broad ligament—this variety is termed *colporrhexis*.

If the birth has been spontaneous the cervix need not be inspected; but it should be examined if an operative delivery (high forceps, traction on the breech, version) has been employed.

Generally speaking, cervical laceration is associated with no immediate symptoms. If, however, the uterine vessels are torn a profuse hæmorrhage (*traumatic postpartum hæmorrhage*, p. 560) may result which closely simulates ordinary postpartum hæmorrhage, but which can be distinguished from the latter by the fact that it continues even although there is good uterine retraction.

In some instances the lacerated cervix heals satisfactorily, even although it is left unstitched, but in most cases it does not do so, and a large ragged gaping cervix results, which later is associated with all manner of pelvic discomforts (p. 909). Besides, there is the immediate risk of acute infection of the wound and the development of a cellulitis (p. 647). Nor must it be forgotten that a ragged lacerated cervix predisposes to carcinoma at a later date (p. 772). The cervix should, therefore, be carefully stitched in the manner indicated in the accompanying illustration (Fig. 246), where it is shown pulled down by volsella, and three catgut sutures are seen in position.

Where the cervical laceration is very extensive, and involves the lower part of the broad ligament, it may be impossible to coapt the torn edges satisfactorily. In such cases if the bleeding is at all pronounced the wound should be tightly plugged with gauze, a pad applied over the fundus, and a firm binder placed round the abdomen. The gauze should be removed in forty-eight hours. Some weeks later the cervix should be repaired.

(d) **Rupture of the Uterus.**—It is convenient in dealing with this complication to discuss it under three heads: (1) rupture during



FIG. 246.—Laceration of Cervix, showing Catgut Stitches Inserted.

pregnancy; (2) rupture early in labour; and (3) rupture after a prolonged labour. But besides this subdivision we would point out that the rupture may be either (a) *complete*, or (b) *incomplete*. In the former the tear extends into the peritoneal cavity; but in the latter it does not extend through the peritoneal coat.

(1) RUPTURE DURING PREGNANCY.—Rupture of the uterus during pregnancy generally occurs in the later weeks, although a few instances of acute rupture from falls, or direct injury to the abdomen, have been recorded in the earlier months.

One of the commonest causes of rupture in pregnancy is a weak uterine scar following Cæsarean section (p. 730), but it has also followed the manual removal of the placenta at a previous parturition, or over-energetic curettage. There are also cases in which the rupture is due to an unrecognised injury to the uterus at a previous confinement, especially if the delivery has been difficult.

With certain forms of uterine malformation rupture is not infrequent (p. 102). Then again there have been a few cases recorded in which rupture occurred where the uterine wall was extensively invaded by a hydatidiform mole (p. 303).

The evidence that the accident may result from disease of the uterine wall owing to degeneration of the tissues is not convincing, although there do appear to be a few cases in which hyaline fatty or fibrous degeneration is the only explanation for its occurrence. In such cases the patients have generally borne many children.

Rupture of uterus in pregnancy almost invariably extends into the peritoneal cavity (complete). It is generally sudden, the foetus being forced through the rent into the peritoneal cavity. Consequently it is usually associated with such symptoms as severe abdominal pain and collapse. Where these symptoms are present, the diagnosis is not difficult.

In a certain number of cases, however, especially where the rupture has resulted from a weak uterine scar, or an injured uterine wall, the rupture may be more gradual, *the foetus (often with membranes intact and placenta) being slowly extruded through the wound*. In such cases the symptoms of acute abdominal pain and collapse are not so pronounced at first; they come on more gradually. This condition may escape recognition for some hours, and even for days. Indeed, in a few instances weeks have passed before it has been recognised. The reason why rupture in the circumstances may be associated with relatively few symptoms is because (a) the rupture is gradual; (b) the retraction of the uterus arrests hæmorrhage from the wound.

The *treatment* consists in abdominal section, removing the foetus and then performing supravaginal hysterectomy. For such ruptures we do not advise stitching the wound and conserving the uterus.

(2) RUPTURE OF THE UTERUS EARLY IN LABOUR.—In this particular

variety the ætiology is very much the same as for rupture in pregnancy. In a considerable number there is reason to suspect that at a previous parturition the uterus has been seriously injured although the injury has not been recognised—very generally in cases of this group there is the history of previous difficult or protracted labours.

The rupture is practically always sudden. The patient complains—generally at the height of a uterine contraction—of a severe tearing pain and the feeling of something having given way. She presents very soon the typical symptoms of collapse, such as rapid thready pulse, subnormal temperature, etc. If the abdomen is examined, the outline of the uterus may be found to be much altered. Instead of the ordinary oval shape, it may present the appearance of a double swelling, one being the extruded, or partially extruded, foetus, the other the retracted uterus. This alteration in outline of the abdominal swelling is most marked and most easily appreciated when the foetus has only partially escaped through the rent. Where the foetus is free in the abdominal cavity, the retracted uterus may not be easily differentiated from the foetus. On the other hand, the foetal parts can be defined very exactly through the abdominal wall. The rupture in this variety may be complete or incomplete.

The *treatment* of this condition is immediate abdominal section, removal of the foetus, followed by hysterectomy.

(3) RUPTURE OF THE UTERUS AFTER PROLONGED LABOUR.—This

is the commonest variety of rupture encountered, and almost invariably it is the result of injudicious management or faulty technique. The tear generally occurs through the lower uterine segment, which, as we have seen, becomes very much thinned out in an obstructed labour. From there the laceration may extend into the upper part of the body of the uterus, downwards into the vagina, or laterally into the broad ligament, and occasionally anteriorly into the bladder. It may be "complete" or "incomplete." In a large number of instances the laceration is of the incomplete variety.

As we shall see in a moment, many of the ruptures are not recognised prior to delivery; indeed, a number actually occur during delivery. Should the rupture occur prior to delivery, the uterine contents may escape into the peritoneal cavity, and lie free amongst the intestines.

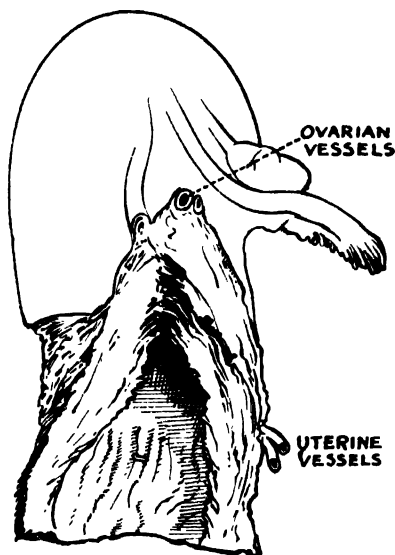


FIG. 247.—Rupture of Uterus.

In not a few cases the child only partially escapes through the rent this is especially observed in the incomplete variety.

Ætiology.—Rupture of the uterus of the variety we are now considering is usually the result of employing the wrong method of delivery, and occurs during the delivery. It is, therefore, termed “violent rupture.” In a number of instances, however, it occurs spontaneously, and is spoken of as a “spontaneous rupture.” But even in these latter cases the accoucheur cannot be altogether exonerated, as, although the rupture is spontaneous, he has generally been given ample opportunity earlier in the labour to correct or deal with the abnormality which has been the cause of the accident.

Three conditions specially favour its occurrence: (a) contracted pelvis; (b) impacted shoulder presentation; (c) hydrocephalus.

In a work of this kind we cannot discuss ætiology in great detail, but as regards the first factor, *contracted pelvis*, it is generally found that the degree of contraction is not extreme; thus the accident is more liable to occur in cases of slight contraction which are easily overlooked. The second ætiological factor—viz., a *neglected transverse presentation*—is responsible for somewhere about 30 per cent. of ruptures. Here the rupture is generally violent, and results from attempts to turn the child. The limb being seized and dragged down, the head is forced through the thinned-out lower uterine segment. *Hydrocephalus*, the third commonest cause of rupture, is associated with great distension of the lower uterine segment, so that if attempts are made to deliver either the fore-coming or after-coming head without *previously perforating it* (p. 484), *rupture readily takes place*.

To the above three grave complications have to be added other malformations of the child, unfavourable positions and presentations (occipito-posterior, face and brow) and an unusually large child.

Clinical Features and Symptoms.—Before discussing the actual signs of rupture of the uterus in obstructed labour, it is necessary to remind our readers of the general condition of the patient, and of the parturient canal prior to rupture. Such symptoms are often termed the “premonitory symptoms” of rupture of the uterus (p. 428). They are a progressive rise of temperature and pulse, a more or less constant pain in the lower part of the abdomen, very short intervals and later no intervals at all between the uterine contractions (tetanic contraction of uterus), great restlessness, and finally the definite formation of Bandl’s ring, which rises to a high level and is distinctly palpable. In a woman with these symptoms, rupture of the uterus may occur at any moment (*vide* Obstructed Labour, p. 428).

The actual rupture may occur suddenly with all the symptoms of collapse, etc., already referred to in connection with the other varieties. *But, as in many cases the rupture results from faulty technique in the delivery while the patient is under anæsthesia, the accoucheur may not be aware until the child has been extracted that rupture has occurred.*

Therefore the classical symptoms of rupture of the uterus, such as collapse, alteration in shape of the uterus, etc., are not present, and are not available for diagnosis. So it comes about that this condition, easily recognisable when it occurs before delivery, is often overlooked, until progressive collapse from shock and internal hæmorrhage, following delivery, arouse suspicion that something serious has happened.

Prognosis.—The prognosis for the child is absolutely bad, and very few are rescued even by abdominal section. As regards the mother, it is also very unfavourable, because even after hysterectomy there is considerable risk of the patient succumbing to septicæmia from previous infection of the parturient canal. *As a matter of fact, most of the fatalities in cases operated upon are the result of sepsis, and not from shock and/or hæmorrhage, although the latter, by lowering resistance, predispose to*

Treatment.—Prophylactic Treatment.—The prophylaxis of rupture of the uterus consists in the proper management of the specific complication. We must, therefore, content ourselves with merely mentioning one or two important matters which deserve special attention. As rupture of the uterus so commonly occurs in *minor degrees of contracted pelvis*, we would again remind our readers of the necessity of correctly appraising the degree of obstruction and not blindly extracting the child by force. Then, as regards *transverse presentation*, where the shoulder is impacted, version should never be performed unless the child can be easily turned; decapitation is the operation which should be employed (p. 749). Not only is version for impacted shoulder more dangerous and difficult as compared to decapitation, it is purposeless, as with few exceptions the child is extracted dead or seriously injured. As regards *hydrocephalus*, the accident will only occur if the hydrocephalus is overlooked, for the child can easily be extracted after the head is perforated (p. 484).

Whenever a labour is unduly prolonged, and before the patient shows evidence of "distress" (p. 428), she should be anæsthetised and the condition investigated. An exact diagnosis is practically always possible if the patient is carefully examined; but in some instances a complete examination can only be made, and an exact diagnosis reached, by passing the whole hand into the parturient canal, which in the circumstances must be done with the greatest caution.

Active Treatment.—Where rupture of the uterus occurs, the accoucheur is face to face with one of the most serious complications in obstetric practice. Its gravity comes only second to the gravest forms of "concealed accidental hæmorrhage" (p. 586).

Preparations should be made for abdominal section. The patient should be removed to a nursing home or hospital, and this is generally safe, for with the child outside the uterus the latter usually retracts, while if the child is only partially through the rent its trunk acts as a plug and arrests all bleeding.

Should the child be still within the uterus it may be advisable to extract it by the vagina prior to performing hysterectomy; but, because of the danger of increasing shock, it is generally advisable to remove uterus and child through the abdomen. Should the child be in the abdominal cavity, either partially or completely, no attempt to deliver per vaginam is permissible. As in a large proportion of cases, however, the child is delivered before the rupture is recognised, the only matter for consideration is the treatment of the ruptured uterus.

If the *child has been delivered by the vagina* two courses are open : (a) to plug the rent with gauze and administer pituitrin ; (b) abdominal section followed by hysterectomy or suturing the rent in exceptional cases. But if the *child has been extracted through the abdomen* hysterectomy is the only procedure.

The results from plugging are surprisingly good, especially where the rupture is "incomplete." They are not quite so satisfactory in cases of "complete" rupture, for in them the gauze pushed through the rent escapes into the general peritoneal cavity and the rent cannot be so effectively packed ; although, even in these cases, a large number of successes have been recorded. When inserting the gauze it will be found of advantage to steady the uterus from above and exert traction on the cervix with volsella from below. *We mention plugging the rent first, and point out the relatively good results secured by it, not because we think it the ideal treatment, but because in many instances it is the best in the circumstances—take, for example, the case where the accident occurs in an outlying country district, where it is difficult or almost impossible to have the patient removed.* If this method of treatment is selected, pituitary extract should be given, and repeated if necessary. Further, a pad should be placed over the fundus of the uterus and an abdominal binder applied. The gauze should be removed after forty-eight hours. Later, when the patient has completely recovered, the advice of a gynæcological surgeon should be taken as to whether or not hysterectomy should be performed, for naturally there would be danger of the cicatrix giving way if a subsequent pregnancy occurred.

Undoubtedly the best treatment, when it is at all possible, is abdominal section. In recent years the results from operative treatment have steadily improved. The ideal procedure is complete hysterectomy (panhysterectomy)—viz., removing the cervix as well as the body of the uterus. If the cervix is left behind there is special danger of infection of the pelvis resulting, as the cervix is almost always heavily infected, owing to repeated examinations and manipulations. Most operators, however, employ the simpler procedure of subtotal hysterectomy. Details regarding the manner of performing these operations are described in Chapter LVII.

Very seldom indeed is it advisable to stitch up the laceration, as

the cicatrix which results readily ruptures in a subsequent pregnancy or labour.

If the broad ligament is extensively lacerated it should be drained by a rubber tube and gauze placed in the cellular tissue. The tube and gauze are removed by the vagina four or five days later (*vide* Pelvic Drainage, p. 1069).

After the operation the patient should be placed in the Fowler position if her cardiac condition will permit of it, and a saline or blood transfusion should be given (p. 564). This is one of the conditions in which blood transfusion may be specially beneficial.

In fatal cases of rupture of the uterus, the majority of women die from sepsis and shock, not from hæmorrhage. Excessive hæmorrhage, although quite frequently encountered, is by no means as common as is generally supposed.

(e) **Injuries to Bladder, Ureter and Rectum.—Injury to the Sphincter of the Bladder.**—The most common injury to the urinary tract resulting from parturition is overstretching and tearing of the sphincter of the bladder. This injury causes a partial incontinence of urine, the patient complaining of escape of urine on sneezing, coughing or straining—hence the term *stress incontinence* for this condition. During the night while she is at rest in bed there may be no leakage of urine. It must be distinguished from a mild inflammation of the trigone of the bladder. In this latter condition, however, there is no incontinence; the patient's complaint is of pain and frequency of micturition. From vesico-vaginal fistula it can easily be distinguished, as in vesico-vaginal fistula the escape of urine is continuous and can be observed by inspecting the vagina.

The injury arises from overstretching of the sphincter muscle and *is specially prone to follow forceps delivery if the bladder has not been thoroughly emptied beforehand*, or if any portion of the anterior vaginal wall is dragged down in front of the presenting part, and not pushed up above the presenting head during extraction by forceps. Even in a spontaneous delivery the injury may occur if the lower section of the anterior vaginal wall is allowed to be pushed down in front of the head. On examining the parts there is nothing to be seen beyond perhaps a slight prolapse of the anterior vaginal wall. This condition is difficult to cure, even by operative means. The operation generally employed is described in Chapter LV.

Injuries to Urethra.—Occasionally the urethra is seriously injured, more particularly where symphysiotomy is employed in unsuitable cases, and the child is forcibly extracted (p. 717). The writer has seen extensive tears of the urethra result in this way. Occasionally, also, in difficult forceps deliveries serious bruising and tearing may occur. The torn canal should be carefully stitched with fine chromicised catgut.

Urinary Fistulæ.—These injuries are commonly grouped under the term “vesico-vaginal fistulæ”; occasionally, however, the fistula is not between the bladder and vagina but between the bladder and cervical canal, or between the ureter and vagina.

There are three varieties of urinary fistulæ :—(1) vesico-vaginal ; (2) vesico-cervical ; (3) uretero-vaginal.

(1) **VESICO-VAGINAL FISTULA.**—This is the commonest variety of fistula, and results from (a) injury by instruments ; (b) more generally a localised sloughing of the part from prolonged pressure by the head. Thus it most commonly follows protracted labour. Where the injury

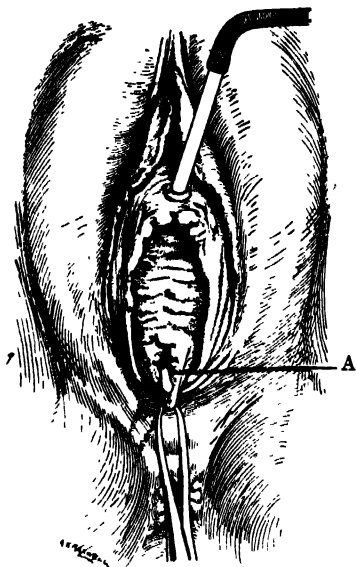


FIG. 248.—Vesico-Vaginal Fistula.
A. Showing droplet of coloured fluid escaping from small fistula.

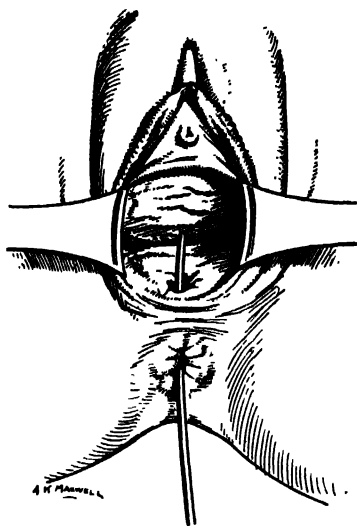


FIG. 249.—Recto-Vaginal Fistula.
Probe has been passed from bowel into vagina.

is produced by direct tearing—as, for example, during the operation of craniotomy or decapitation—incontinence of urine is present from the first ; but where the fistula results from necrosis due to pressure, then it may be a day or two before the necrosed area sloughs and urinary incontinence is noted.

Diagnosis.—The diagnosis of a vesico-vaginal fistula is not difficult, provided the opening is large, and within easy access. It is generally situated in the upper or middle third of the anterior vaginal wall, and can be felt by the fingers or seen through a speculum. If there is any doubt, sterile fluid, coloured with milk or aniline blue, should be run into the bladder. This coloured fluid, if there is a fistula, will be seen trickling through the opening (Fig. 248).

Treatment.—Where the fistula results from direct tearing of the

parts, and is recognised at the time of its infliction, it may be possible to repair the injury by carefully stitching the ragged edges. In most instances, however, as the incontinence is not noted for some time, and, as already explained, does not occur until the slough separates, immediate repair is not possible.

The operation for vesico-vaginal fistula is described under Gynæcological Operations (Chapter LV).

(2) **VESICO-CERVICAL FISTULA.**—This fistula, which is a rare accident, generally results from forcible extraction of the child through the undilated cervix, with serious laceration of the cervix. In some cases, however, it may occur spontaneously from pressure with subsequent sloughing.

Diagnosis.—The diagnosis of this variety is not so simple as the vesico-vaginal one, for the opening in the bladder can seldom be felt. It can always be recognised by running some coloured fluid into the bladder and observing if this escapes through the cervical canal.

Treatment.—This fistula is specially difficult to repair, as it is so inaccessible (*vide* Chapter LV).

(3) **URETERO-VAGINAL FISTULA.**—This is a very rare complication in obstetric practice. It more commonly occurs as a result of injury during hysterectomy (Chapter LVI). This variety fistula is situated high up in the vaginal vault, and to one or other side. Urine can generally be seen coming through the fistula if the vaginal walls are retracted; but it may escape very slowly.

In this condition half or more of the urine may be passed *per urethram*—the amount can be determined by measuring the quantity passed. The introduction of coloured fluid into the bladder is of no assistance in the diagnosis as the fluid does not escape through the fistula unless the tear involves the bladder as well as the ureter. A cystoscopic examination may be advisable.

Treatment.—It is generally impossible to repair this type of fistula from the vagina. The best procedure is to perform abdominal section and reinsert the ureter into the bladder.

Recto-vaginal Fistula.—Fistulae of this nature are very rarely encountered except at the outlet of the vagina. They result from imperfect union of the lacerated edges of a complete perineal tear and are generally small in size (Fig. 249). Frequently the patient is only conscious of the existence of the fistula when the bowels are loose or when she passes flatus. She often volunteers the information that flatus comes through the vagina.

Treatment.—A fistula of this nature can only be repaired by dividing the bridge of tissue and treating it as a complete perineal tear. It is generally found that to repair the fistula by paring and stitching the edges is futile.

There is a very rare developmental error in which a congenital fistula exists—it is termed a “vaginal anus” (p. 105).

Hæmatoma Vulvæ.—This condition (Fig. 250) is an effusion of blood into the cellular tissue of the vulva and vaginal wall. It most commonly occurs during labour, but occasionally we have observed it in pregnancy. It comes on quite suddenly, and is associated with severe pain, the patient sometimes describing the onset as a sudden tearing pain, followed by a feeling of fullness as if the part were going to burst. It may extend round the perineum, and occasionally assumes large dimensions. If it becomes infected, very extensive sloughing of the parts may result.

Treatment.—If slight, rest and the application of hot antiseptic fomentations or evaporating lotions will result in the effusion becoming absorbed. But if the effusion is at all extensive, it is advisable to incise the part and remove all blood-clot so as to prevent, if possible, serious and extensive sloughing.

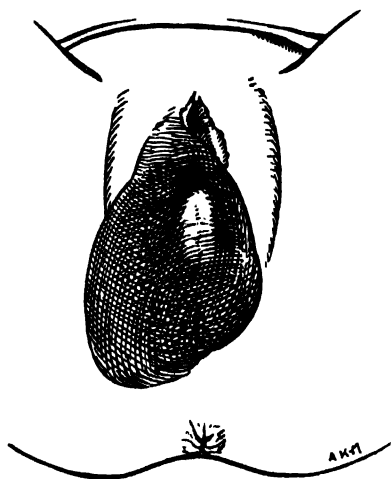


FIG. 250.—Hæmatoma Vulvæ.

Retroperitoneal Hæmatoma.—

This very rare complication is an effusion of blood into the broad ligament. The accident occurs during pregnancy, seldom during labour. It very closely resembles (a) concealed accidental hæmorrhage, (b) spontaneous rupture of the uterus, (c) extrauterine pregnancy in broad ligament (p. 343). It can be distinguished from *concealed accidental hæmorrhage* (p. 586) by the fact that the uterus is not tense and tender, from *rupture of the uterus*

(p. 597) by careful examination, although in some cases it may be impossible to distinguish the two complications until the abdomen is opened. It can be distinguished from *extrauterine pregnancy* by the history and physical examination; radiography in some instances may be helpful.

Symptoms.—The symptoms are severe pain to one or other side. Most commonly the hæmorrhage occurs into the *left* broad ligament, with a tearing pain and sudden collapse. The collapse may become very pronounced, and large effusion of blood may occur into the broad ligament, if vessels of large calibre are lacerated. Effusions extending as high as the kidney pouch have been observed.

Treatment.—As the condition may be indistinguishable from rupture of the uterus or from broad ligament extrauterine pregnancy by ordinary methods, the abdomen should be opened if there is any doubt, and the parts carefully examined. If rupture of the uterus has occurred then hysterectomy is indicated; if extrauterine

pregnancy exists, the condition is dealt with as described elsewhere (p. 357). But if the condition is recognised beforehand as a hæmatoma, or found to be this after the abdomen is opened, the broad ligament should be opened, the blood-clot removed, the sac packed with gauze, and an end of the gauze brought out through a counter-opening in the vagina. It may be deemed advisable to perform Cæsarean section in the event of the accident occurring late in pregnancy.

(f) **Other Rare Injuries.—Emphysema.**—This complication is a relatively rare one, and is almost invariably associated with a severe labour in which the “bearing-down” efforts are very strong. The subjects are generally primiparæ.

The condition arises from rupture of the air vesicles at the root of the lung. The air forced out extends underneath the pulmonary pleura into the anterior mediastinum, and through the fascia around neck and chest. Some writers maintain that the injury may be in the respiratory tract higher up.

It is not usually recognised immediately after the delivery: an hour or two generally elapses before the typical “crinkling” sensation in the cellular tissue is appreciated. Very often a considerable amount of pain is complained of in the region of the seventh or eighth ribs, especially if a deep breath is taken. The outlook is good, and the patients invariably recover. No treatment, additional to the administration of a sedative, is necessary unless there is excessive pain during respiration, when the affected side should be strapped.

It occasionally happens that a subcutaneous emphysema of the wall of the lower abdomen follows a rupture of the uterus if air is introduced into the parturient canal. The air in such cases gets into the cellular tissue of the broad ligament and thence to the abdominal wall.

Fracture of Sternum.—There have been a few cases recorded in which a rib and even the sternum has been fractured by violent bearing-down efforts.

Hæmatoma of Rectus Abdominis Muscle.—This is a rare complication, and may occur either during pregnancy or labour. It occurs generally during parturition where there have been great straining efforts. The whole muscle is very tender, but the effusion of blood is localised. Absorption occurs in a few weeks.

CHAPTER XXXV

STILL-BIRTHS AND NEONATAL DEATHS—ACCIDENTS AND INJURIES TO THE CHILD DURING PARTURITION—ASPHYXIA NEONATORUM—OPHTHALMIA NEONATORUM—UMBILICAL INFECTION

DURING the present century the infant death-rate for England and Wales has fallen from 140 to 55 per 1000 live- and still-births; but the number of still-births and neonatal deaths has diminished only very slightly. Here is the position as presented in the last "Text" volume (1937) of the "Statistical Review of the Registrar-General of England and Wales."¹

RATES PER 1,000 LIVE- AND STILL-BIRTHS

	Still-births.	Neonatal Death-rate (Ages 0-4 Weeks).	Combined Rate.
1928	40.1	29.8	69.9
1929	40.0	31.5	71.5
1936	39.7	29.0	68.7
1937	(24,806) 39.0	(18,168) 28.6	67.6

The subject is reviewed by Professor Charles McNeil in Chapter XXXVIII (p. 667).

Intrauterine death during pregnancy has been considered in Chapter XV (p. 318). In this chapter we propose to discuss more particularly accidents and injuries to the child during parturition. For many, the accoucheur cannot be held responsible; but for some he is responsible—they are the result of minor or major errors in judgment or in technique in the conduct of the labour.

PLACENTA AND CORD

Prolapse of Cord.—This is amongst the commonest complications leading to foetal death during parturition (p. 498). It, as we have seen, may be easily overlooked if a small loop of cord comes down.

CORD WOUND ROUND THE NECK OF CHILD.—In this condition the cord may be unduly pressed on, especially during the second stage of labour if there is delay in the exit of the head through the vulvar outlet, for the cord in such cases may be pressed between the child's neck

¹ In the last two years (1941, 1942) there has been a fall in both still-births and neonatal deaths.

and the symphysis pubis. We would emphasise the importance of this as a cause of foetal death during a normal labour. It has been found that in some 20 to 25 per cent. of still-births no obvious cause can be found for the death. Some of these deaths are undoubtedly due to pressure on the cord as described.

Abnormal Position of Placenta and Attachment of Cord.—These conditions are important causes of death of the foetus. *Placenta prævia*, where location of placenta is at fault, is, as we have seen, associated with a high foetal mortality. *Accidental hæmorrhage* is also associated with a high foetal death-rate (p. 588). Frequently the placenta comes away immediately after the child, its attachment being so slight. In most of such cases there has been “accidental hæmorrhage,” but in some, examination of the placenta reveals no such occurrence, only a general degeneration of the placenta. Reference must also be made to abnormal attachment of the cord, such as a battledore or velamentous insertion (p. 311). In such conditions death of the foetus may result from rupture of a vessel—the child actually bleeds to death (p. 503).

LARGE FŒTUS AND POST-MATURITY

As regards the *foetus itself*, abnormal size and excessive ossification of head are predisposing factors ; as also is undue softness of the head from faulty ossification. These factors are of the greatest importance if, in addition, the presentation or position is faulty or if there is any pelvic disproportion.

Again, post-maturity (p. 183) increases materially the chances of death of foetus during labour, as in such cases not only may the child be larger than normal but the placenta may be more degenerated, owing to thrombosis of the vessels. In rare cases the post-mature child may be puny and small owing to excessive degeneration of the placenta.

INJURIES TO THE SOFT PARTS

Bruises and Lacerations.—These to the face and sides of the head are not uncommon in difficult forceps deliveries. Any wound of this kind should be carefully dressed, serious infections and even death from septicæmia may result from neglect of this precaution. *The newborn infant's resistance to infection is poor* (p. 668).

More grave injuries, such as tearing of an ear or actual removal of the pinna, and grave injuries to the eyeball with even bursting of the eyeball or enucleation, occasionally happen. Such injuries almost invariably occur in very difficult forceps deliveries, and generally speaking where there is pelvic deformity or a distinctly unfavourable presentation of the head. They are therefore avoidable if care is exercised in the selection of treatment where pelvic disproportion

exists, and if malpositions and malpresentations of the head are corrected before forceps is applied.

Cephalhæmatoma.—We have seen that in all vertex presentations an oedematous swelling known as the *caput succedaneum* (p. 395) forms over the presenting part. It is a localised œdema of the scalp within the circle of pressure, and disappears in forty-eight hours. The condition of *cephalhæmatoma* is quite different, for it consists of effusion of blood beneath the pericranium. It is to be distinguished from the ordinary *caput succedaneum* by the fact that the swelling being underneath the pericranium is limited by the sutures of a particular bone. The usual situation is on one or both parietal bones (Fig. 251); but it may form on the occipital or frontal bones and is frequently



FIG. 251.—Cephalhæmatoma.

bilateral. It may not be evident until some hours after delivery. Curiously enough, it is not peculiar to difficult labour; indeed, it often follows spontaneous and precipitate labour. It is very slow in disappearing. Its edges become hard and raised, for a certain degree of bony formation occurs at the margins of the effusion; this disappears later. The condition sometimes accompanies a fracture of the underlying bone.

It is advisable to treat the condition expectantly, although months may elapse before the swelling disappears entirely. If incised or aspirated, every possible precaution must be taken to prevent infection—we do not advocate this procedure and have always employed and been satisfied with expectant treatment.

Hæmatoma of the Sternomastoid Muscle and Torticollis.—Occasionally it happens that some of the fibres of the sternomastoid muscle are torn. The accident is the result of undue torsion of neck. This may occur spontaneously in the course of the labour, but more often it is artificially produced during actual delivery. The effusion occurs

into the substance of the muscle, and most commonly in the lower part of the muscle. The effusion is seldom of any size and disappears entirely, although absorption may be very slow. In some instances, however, a torticollis has followed this injury, although most cases of torticollis are probably due to injury of the spinal accessory nerve or the cervical plexus.

INJURIES TO BONES

Fracture of Skull and of Cervical Vertebrae.—In most cases these injuries occur during a parturition in which the labour has been protracted owing to disproportion between the foetal head and the maternal pelvis. In some, the force of the uterine contractions has been sufficient to overcome the obstruction in the parturient canal, and the injuries, therefore, may be described as *spontaneous*. But, speaking generally, the delivery has been terminated by forceps or traction on the lower limbs, and the injuries are therefore the result of violence. Occasionally very extensive fractures are directly produced by the blades of the forceps, more especially if the child's head has been grasped obliquely—the occipital and frontal bones then suffer most. More frequently, however, the fracture has not been directly caused by the forceps; it has been produced by the projecting promontory of the sacrum—in this event the parietal and frontal bones are those usually injured.

In recent years, by means of X-rays, more accurate observations regarding injuries to the occipital bone and upper cervical vertebrae have been possible, with the result that the causes of still-birth have been further elucidated. There have been some very interesting investigations in this connection in recent years.

The occipital bone, in the foetus, consists of four component parts—the squamous portion behind, the two lateral portions and the basilar portion in front—separated by cartilage. It is obvious, therefore, how very vulnerable this bone is, and how easily it may be injured when the occiput is pressed hard against the rami of the pubes during forceps delivery or extraction of the after-coming head. Apart from the injuries resulting from forceps and breech deliveries, there are undoubtedly a few cases in which the injury is produced by the fingers of the operator pressing on the occipital bone in his attempts to maintain flexion of the head during delivery of the after-coming head, and even occasionally during delivery of the fore-coming head. Fracture may even take place during a spontaneous delivery.

Injuries to the cervical vertebrae have long been known to account for many foetal deaths, in breech deliveries more particularly; although similar injuries may also result from forcible traction on the fore-coming head if the shoulders are arrested. *We would here stress the dangers of one particular manœuvre, viz., rotation of the occiput forwards*

in an occipito-posterior position if the shoulders of the child are fixed. This subject has been fully considered elsewhere (p. 448).

One other condition which possibly may account for some foetal deaths during labour calls for mention. If the *foetal head is well down in the pelvis a sudden change of the mother's position from the recumbent to the erect or even sitting posture may bring about a fracture of the cervical vertebræ, or pressure on the spinal cord in the region of the second and third vertebræ, with fatal consequences.* The accident is most likely to happen in a multipara with a pendulous abdomen.

We point out these different injuries, not with any idea of minimising the importance of intracranial hæmorrhage from tearing of tentorium or falx cerebri, which are accepted as the most important causes of foetal death from trauma. Our purpose is to direct attention to other lesions which are found at autopsy, but do not receive so much consideration. In some 12 to 15 per cent. of autopsies of fresh still-born children spinal injuries have been discovered. Long years ago Spencer,¹ in his historic monograph, pointed out the frequency of such lesions. In the light of more detailed examination of the vertebral column, we now know that *following breech deliveries* the proportion of foetal deaths (intrapartum and neonatal) due to spinal injuries is considerable (30 to 40 per cent.).

Indentation of the Skull.—Indentations of the skull are either furrow-shaped or spoon-shaped. The furrow-shaped variety are the less serious, and seldom give rise to much immediate disturbance. They may be of various forms. They are confined to the parietal or frontal bones. More serious are the *spoon-shaped indentations*, for in many cases they are associated with fracture of the indented portion of bone.

The injury is usually situated on one or other of the parietal or frontal bones in the neighbourhood of the anterior fontanelle. With few exceptions it occurs where there is deformity of the maternal pelvis, most commonly a deformity of only a moderate degree. The indentation is caused by the head being pressed or pulled against the projecting sacral promontory. Defective ossification of the skull predisposes to the accident.

The simplest operation is to make an incision through scalp and pericranium along the lower margin of the depression, cut the bone with elbowed scissors, and then inserting a flat elevator (handle of scalpel) between the dura mater and skull, raise the indentation. In the illustration (Fig. 252) is seen the result from such an operation. There is no flap turned down; if this is necessary, then the incision should be made along the upper margin of the indentation.

Less importance is attached to indentation of the skull to-day than formerly. There occur, however, odd cases in which the indentation

¹ "Visceral Hæmorrhages in Still-born Children: an Analysis of 130 Autopsies," *Trans. Lond. Obst. Soc.*, 1892, vol. xxxiii., pp. 203-296.

produces pronounced symptoms of serious portent which are relieved immediately by operation.

Fractures of Other Bones.—The writer has twice observed fracture of the *lower jaw* ; it was caused by the tip of the blade of the forceps. The bones most liable to be fractured are the clavicle, humerus, and femur. The accident most commonly occurs in bringing down the limbs in breech presentations.

Fractures of the clavicle are frequently incomplete, but those of the *humerus and thigh* are generally complete, the bone being broken right across.

An injury to humerus, very easily overlooked, is *separation of upper*

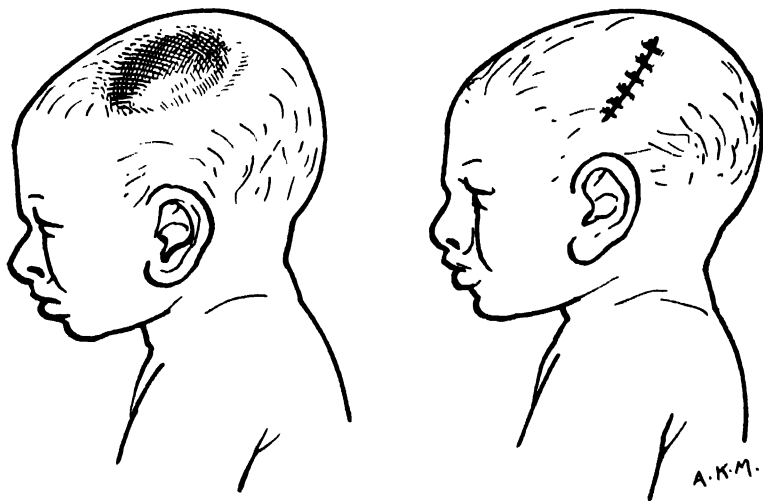


FIG. 252.—Spoon-shaped Indentation of the Left Parietal Bone. Right-hand figure shows the indentation raised and scalp stitched.

epiphysis from diaphysis. A varying degree of deformity results. In the more grave form the arm hangs paralysed, and may simulate Duchenne's paralysis. In all cases a radiograph should be taken ; but, unfortunately, it cannot always be demonstrated by X-rays, as the upper epiphysis of the humerus may not show any ossification at birth.

INJURIES TO ABDOMINAL AND THORACIC VISCERA

Injuries to the abdominal and thoracic viscera, if they are sufficiently marked to be recognisable, usually prove fatal. Probably the more heroic methods of resuscitation are responsible for most of the cases of ruptured liver or hæmorrhage into the lung, although, in cases of asphyxia in which there is great venous engorgement of viscera, spontaneous hæmorrhages may occur. It is common to find, at post-mortem examination of infants dying of asphyxia, petechial

hæmorrhages scattered over the pleura and pericardium, and retina. Many of these slighter petechial hæmorrhages are probably the result of asphyxiation, and are not primarily the cause of death. *Particularly serious are hæmorrhages into the suprarenals.* The importance of this last-mentioned lesion is stressed by Ehrenfest and several other authorities.

INJURIES TO BRAIN, SPINAL CORD AND PERIPHERAL NERVES

Cerebral Hæmorrhage.—Amongst the earliest and most important investigations into this subject was that made by Spencer, to which reference has already been made. In more recent years an extensive literature has accumulated on the subject. The contributions from this country by Eardley Holland and Lane-Claypon and by Norman Cruickshank call for special mention. Ehrenfest, in his volume on "Birth Injuries of the Child," presents the subject very completely and gives a full bibliography.

Hæmorrhage on the brain surface and into the brain substance was referred to by many of the earlier writers ; but it has come to be realised that most intracranial hæmorrhages which prove fatal are due to tears of tentorium and/or to the falx cerebri—the blood comes chiefly from the vein of Galen. Intracranial hæmorrhages are found in 40 to 50 per cent. of dead births and neonatal deaths (Fig. 253).

It is not difficult to realise how oblique or antero-posterior grasp of head with forceps or forcible traction on the after-coming head in breech presentations, or, indeed, extreme moulding of the head in a spontaneous delivery, may on occasions produce the injuries we are considering. Further, our readers can readily understand that the premature child, with tissues more delicate and cranial bones less ossified and more mouldable, is very easily injured. The dura mater is so vascular and easily torn that *stresses and strains* insufficient to cause intracranial damage to the mature infant may readily cause meningeal tears in the premature child. The hæmorrhagic diathesis may account for the hæmorrhage in some cases ; for that reason it is advisable to test the coagulation time of the infant's blood.

Diagnosis of intracranial hæmorrhage in the child born alive may be difficult. Muscular rigidity or paralysis, feeble cry and inability to suck, squint, convulsions, respiratory disturbance, and intermittent attacks of cyanosis are all signs commonly found. Of these, convulsions and intermittent attacks of cyanosis are the most important physical signs. A tense bulging anterior fontanelle suggests hæmorrhage into the cerebral ventricles. Lumbar puncture often clears up the diagnosis. A blood-stained or definitely yellow cerebro-spinal fluid is proof of intracranial bleeding, provided that blood has not been introduced from vessels injured by the exploring needle.

If death does not occur within the first few days after birth the child may recover completely, though many suffer from permanent disability—*e.g.* spastic paralysis of one or more limbs, hydrocephalus, mental deficiency, and temperamental peculiarities. *All evidence goes to prove that birth injury is rarely, if ever, responsible for congenital idiocy.* It is of very great importance to bear this in mind, because in the past injury at birth has been advanced as the cause of this condition and the doctor or the midwife has been blamed without justification.



*With permission, "Manual of Obstetrics."
(Eden and Holland. 8th Edition, 1938. J. & A. Churchill.)*

FIG. 253.—Complete Bilateral Tear of the Tentorium Cerebelli. On the left hand the anterior edge has remained intact. From a breech labour in a primipara.

There are, as Spencer pointed out, a number of cases of hæmorrhage limited to the parietal region of the Sylvian fissure, and which he attributed to "clamping of the vein (great anastomotic) from pressure of the lower anterior corner of the parietal bone, which immediately overlies the main trunk of the vessel." He attributed great importance to "softness of skull bones and increased mobility of the bones from laxity of the sutures, and particularly of the lower edge of the parietal bone."

Hæmorrhages into the brain substance may be quite independent of trauma, although in many instances it may be secondary to the

injuries already described. One has to remember that asphyxia, from causes other than trauma, may be followed by hæmorrhage into the parenchyma of any organ (brain, liver, spleen, kidneys, etc.).

Skilled nursing is of the greatest importance in the treatment. The child should be disturbed as little as possible, and in cases where the sucking and swallowing reflexes are interfered with, nourishment should be given by the stomach tube. Attacks of cyanosis may be treated with oxygen (carbon dioxide ?) administered through a nasal catheter. Where intracranial pressure is increased, lumbar or ventricular puncture usually gives relief, and may have to be repeated several times. *More drastic operative procedures have not met with sufficient success to warrant their adoption.* If there is delay in the blood-coagulation time, whole blood (paternal) should be injected subcutaneously. In the cases in which convulsions occur (50 per cent.), chloral hydrate should be administered in dosage sufficient to keep the infant under its influence for several days.

Spinal Cord.—We have already indicated the injuries which the vertebral column may sustain and how such injuries may directly damage the cord or produce hæmorrhages on its surface or into its substance. Grave injury to the upper cervical area is necessarily fatal: slight injuries to the lower cervical, dorsal, or lumbar regions may lead to spinal paralysis.

Injury to Peripheral Nerves.—The common peripheral nerves to be damaged are the facial and the upper part of the brachial plexus.

Facial paralysis is almost always caused by pressure of a blade of the forceps on the facial nerve as it passes out of the stylo-mastoid foramen. In the great majority of cases recovery is rapid and complete. In the rare cases in which the paralysis persists the brain or the petrous portion of temporal bone has been injured.



FIG. 254.—Facial Paralysis.

Brachial paralysis, which in most cases is due to stretching of the roots or trunks of the brachial plexus either during extraction of after-coming head, or fore-coming head if there is difficulty in the birth of the shoulders, is a less common but a much more serious injury than damage to the facial nerve. *The injury results from traction on the fore-coming head or on the trunk in breech delivery if the side of head and corresponding shoulder are closely approximated. The result is that the brachial plexus on the opposite side is torn. The accident is almost impossible if traction is made in axis of head and trunk and shoulder and head are not approximated.* The usual muscles to be paralysed are those supplied by the upper two roots of the plexus (fifth and sixth cervical): this type is known as the Erb-Duchenne paralysis. Sometimes the whole arm is paralysed, and there is also a rare type in which the triceps

and the muscles of the forearm are affected—the Klumpke paralysis. In this case the eighth cervical and first dorsal roots, or the trunk they form by their junction, have been damaged.

In *Erb-Duchenne paralysis* the arm is held adducted and rotated inwards; the forearm is extended and pronated. The muscles affected are the deltoid, the supra-spinatus and infra-spinatus, the teres minor, the biceps, the brachialis anticus, and the supinator longus. There is no loss of sensation.

In *Klumpke's paralysis* the forearm is flexed at the elbow and supinated; the hand is flaccid. The muscles affected are the triceps and all the muscles of the forearm and hand, except the supinator longus. There may be narrowing of the palpebral fissure and myosis of the affected side, due to damage to sympathetic fibres in the neck.

Brachial paralysis is usually easily recognised, though loss of function from fracture of the humerus or clavicle may lead to mistaken diagnosis. The pseudo-paralysis of syphilitic osteochondritis is very seldom present at birth, and that of scurvy never. Paralysis from poliomyelitis is never present at birth; paralysis from cerebral lesions is of the upper neurone type.

Early treatment of brachial paralysis is of great importance, for the earlier the treatment is commenced the greater is the hope of recovery. Though immediate surgical treatment was at one time advocated, it is now generally considered inadvisable. As a preliminary measure, until the appropriate splint can be made, the arm should be abducted and rotated outwards and the forearm flexed to a right angle, supinated and laid on the child's pillow. A band of adhesive plaster round the wrist and pinned to the pillow will maintain the arm in this position.

ASPHYXIA NEONATORUM

There has been in the past a great deal of theorising and speculation regarding the genesis of the first respiratory efforts of the child. Reflex peripheral irritation was, until a comparatively recent date, given as the explanation, and all methods to bring about respiration were based on the assumption that peripheral irritation by cold water, slapping, etc., and increased oxygenation of the blood by artificial respiration were the correct procedures. To-day we know that the primary stimulus to the respiratory centre is a gradual accumulation of CO_2 in the blood. Operators have remarked on the fact that the child delivered by Cæsarean section is often in a condition of *apnœa*, in contrast to the child delivered in the ordinary manner, who cries lustily when born; the reason, of course, being that the former, unlike the latter, has not been subjected to the influences which bring about accumulation of CO_2 . It has also been observed that morphia administered to the mother, especially late in labour, or

prolonged chloroform anæsthesia, may cause apnœa in the child. With morphia the duration and extent of the apnœa depend upon when in labour the morphia was administered. Shute and Davis state : "The interval between the administration of the drug and the birth of the baby is the most important factor in the occurrence of neonatal narcosis." They found that it reaches its peak at three and a half hours, then slowly declines, and is pretty well gone by six hours. Scopolamine increases the neonatal narcosis. Here apnœa is due to inhibition of the respiratory centre by the drug.

As labour proceeds to the termination of the second stage : (a) the placental circulation is being repeatedly interfered with by the uterine contractions ; (b) the child, especially its head, is being subjected to external pressure in its passage through the utero-vaginal tract ; (c) the child after birth is subjected to a change of environment, from a liquid medium at 99° to the room temperature of 60° to 70°. The combination of the accumulated carbon dioxide in the blood and the external stimuli result in a gasp or cry and the establishment of respiration and pulmonary circulation.

The causes of asphyxia neonatorum are numerous, but may be divided into three main groups :

1. Traumatism.
2. Interference with the placental circulation.
3. Interference with expansion of the child's lungs.

We would point out that this section deals with *asphyxia*, not with *death* of the child. The conditions mentioned, therefore, apply only in the lesser degrees in which asphyxia is caused and the child is not 'dead-born.'

1. *Traumatism*.—In this group, termed by Barnes many years ago "paralytic asphyxia," the condition is produced by compression or injury to the brain and/or spinal cord. We have come to learn from the many investigations made in recent years that these injuries account for 30 to 40 per cent. of the fatalities, and if present to a lesser degree for a very large proportion of the children born less or more asphyxiated. That being so, it is obvious that the infant must be handled very gently during and after birth.

2. *Interference with the Placental Circulation*.—Interference with the placental circulation may be due to several causes : (a) Premature separation of the placenta, as in placenta prævia or accidental hæmorrhage. (b) Direct pressure on, or constriction of, the umbilical vessels by knots, twists, or prolapse of the cord. (*N.B.*—Occasionally asphyxia results if the cord, twisted round the neck of the child, gets pressed against the symphysis pubis while the child is being born (p. 408). This cause is often overlooked, for the accoucheur has auscultated the foetal heart and found it quite satisfactory before proceeding to deliver the child.) (c) Prolonged labour after rupture of the membranes, accompanied by undue pro-

longation of the uterine contractions, thereby causing interference with the placental circulation. (d) Direct pressure on placenta between uterine wall and child's body. (e) Velamentous or battledore insertion of the cord—the cord coming off the most dependent edge of the placenta is subjected to pressure by the presenting part. (f) Grave diseases of the mother, in which, for various reasons, her circulation is weak or interfered with—e.g. heart and lung diseases, anæmia, hæmorrhage, or the moribund state.

As a result of interference with the placental circulation there occurs a relative increase of carbon dioxide in the blood, so that the respiratory centre in the medulla is excited, and (except where the mouth of the child is closely applied to its own body or to the uterine wall) amniotic fluid, meconium, and mucus may be inspired. Indeed, if air is carried into the uterus, as for example by the operator's hand in performing version, the child may inspire this air and the intra-uterine cry (*vagitus uterinus*) may be heard. On two occasions the writer (J. M. M. K.) has heard this cry quite distinctly.

The next stage is that the medulla becomes poisoned with carbon dioxide and death results. In other cases the death of the child is more gradual, and is really due to an insufficient supply of oxygen.

3. *Interference with the Expansion of Child's Lungs.*—Here the condition is a true asphyxia, as we recognise it in suffocation, drowning, and overlying. It may occur if the child is born with a caul, or has its mouth or nasal passages obstructed by mucus or maternal secretions, or is drowned in liquor amnii, as mentioned later.

It is customary to distinguish two forms of asphyxia neonatorum : (a) asphyxia livida ; (b) asphyxia pallida.

Asphyxia Livida.—In asphyxia livida the skin is dusky red and the cutaneous vessels are turgid. The umbilical vessels are overfilled with dark-coloured blood, and are usually pulsating strongly. The cardiac action is good and not unduly slowed. The muscles are in good tone and the sphincter ani maintains the anus closed.

The prognosis in a simple case of asphyxia livida is good. At first the child may not make any attempts at spontaneous respiration ; but after a brief period feeble respiratory efforts are observed, which are shortly followed by more active attempts, and finally reach a climax in a cry. Treatment of the condition is described later.

Asphyxia Pallida.—In this condition the respiratory centre becomes depressed and finally paralysed by the lack of oxygen and the accumulation of carbon dioxide. The most striking difference is the colour of the skin, which is of a dirty-white colour and entirely without evidence of cutaneous blood-supply. Equally noteworthy is the absolute loss of muscular tone in limbs, back, neck, and lower jaw. A finger introduced into the anus encounters no resistance, as the sphincter ani has lost its power to contract.

Paresis of the cardiac musculature is indicated by enfeebled cardiac

action, and the lack of blood in the skin and umbilical vessels. Hence, the child presents just that very appearance which one sees in a person stricken down in a faint or in a condition of shock following an accident. Gasping attempts at respiration may be made at long intervals—they are entirely diaphragmatic in character, unassisted by the muscles of the thoracic wall. They are futile efforts as little, if any, air reaches the bronchioles.

Should success follow any of the means employed to resuscitate the child, the colour of the skin gradually changes, the cardiac action becomes more forceful and regular, and tonicities returns to the muscular system.

In most cases in which a post-mortem examination is made on a child not resuscitated, the lungs are heavy, of a dark red colour, and show numerous subpleural hæmorrhages from the overfilled, delicate, and very much distended vessels. (If the child has made *intranatal attempts at respiration*, liquor amnii, meconium, etc., are found in the air-passages.) The brain and its membranes likewise participate in the congestion: meningeal effusions and œdema, especially over the cortex and base, are common. Hæmorrhages into the substance of the brain are comparatively rare; but there may be extensive subdural hæmorrhage if the tentorium has been torn. Hæmorrhages into the thoracic and abdominal viscera are very general (suprarenal hæmorrhages are particularly serious (p. 614). The right side of the heart has its cavities distended with dark venous blood, and subpericardial hæmorrhages are frequently noted.

In children who are resuscitated the prognosis is grave. Cerebral extravasations of blood from trauma are responsible for many deaths, and pneumonia carries off a considerable number. *Should resuscitation have been extremely difficult to establish, the prognosis is very grave indeed.*

TREATMENT.—A better understanding of the causes of intranatal death, and an appreciation that the asphyxiated child is in reality suffering from shock in many instances, has completely revolutionised the treatment of asphyxia neonatorum. Gentle handling has replaced violent peripheral stimulation and artificial respiration.

Immediately following the birth, the umbilical cord should be clamped with pressure forceps and divided. The child should then be placed on a pillow and covered with a warm blanket. The head of the child should be depressed slightly and any loose mucus in the upper air-passages removed by a suction catheter (rubber). Gentleness should be exercised in removing the mucus, as it is important to avoid abrading the mucous membrane. By this means insufflation of mucus is prevented when the child makes the first inspiration. Reference has already been made to the heavy toll infection takes. By doing everything possible to prevent abrasions of mouth and throat, and insufflation of mucus possibly infected, one reduces very appreciably the chances of general and pulmonary infection.

More complete removal of secretion can be effected by passing the tube into the trachea—a simple procedure if the child's reflexes are absent, but more difficult if they are still present. Fortunately, in the latter event intubation of the trachea is seldom necessary. *There is, however, one condition in which intratracheal intubation is all-important, viz., cases in which the child has inspired large quantities of liquor amnii.* In such cases the child is literally drowned in liquor amnii, and will certainly die if the liquor amnii is not removed. The tragedy of a perfectly healthy child being drowned may happen when rupture of the membranes occurs or a large quantity of residual liquor amnii gushes out of the vagina and the child at the same time makes a deep inspiration. Drowning of the child in liquor amnii has on occasions occurred following delivery by Cæsarean section. If this accident occurs, the child's head should be depressed, a tube passed into the trachea, and its chest compressed.

The very common procedure, of holding the child by the ankles with the head kept dependent until the first respiratory effort has occurred, is suitable and sufficient for minor degrees of asphyxia. In the graver forms, however, this exposure and handling of the child may aggravate the shock.

The upper air-passages having been thoroughly cleared, further treatment will depend upon the variety and degree of the asphyxia. *In the case of asphyxia livida* a little blood should be allowed to escape from the umbilical cord and moderate peripheral stimulation applied by dashing a little cold water over the child's chest, or by rubbing its chest with whisky or brandy. Violent slapping is bad, as it may produce bruising and shock—we have seen extensive ecchymoses from it. Another method of reflex stimulation is rhythmic traction of tongue, but it is of no great value. If the asphyxia shows any sign of passing into the graver *pallida* variety, oxygen and carbon dioxide should be administered as described later.

The child *apnœic from morphia or other drugs* generally recovers if left alone, because sooner or later its respiratory centre is stimulated by accumulation of carbon dioxide and it begins to breathe. If any anxiety is felt regarding its condition, as indicated by slowing or other alteration in the heart-beat, oxygen and carbon dioxide should be administered. The appearance of the child apnœic from scopolamine and morphine is sometimes rather alarming and occasional deaths occur; but they are relatively few, and practically never occur unless these drugs have been pushed beyond a reasonable limit (p. 416).

We must now consider *the child suffering from asphyxia pallida.* The child should be immersed in a large basin of warm water, and its air-passages cleared while it is in the basin. The water must not be too hot, but sufficiently warm to act as a mild peripheral stimulant. The whole trunk, neck, and back of the head (very important) should be under water; only its face should be above the surface. Nothing

more should be done, but the foetal heart-beats should be noted, and occasionally the child's face should be sponged with the warm water. Epinephrine and coramin, injected into the umbilical vein or the heart muscle, have been tried. More effective is the respiratory stimulant, lobeline hydrochloride $\frac{1}{10}$ grain, into the umbilical vein.

After a minute or two the chest of the child may be gently compressed from time to time (twelve to fifteen per minute). This may induce inspiration and it stimulates mechanically the flagging heart.

It seems hardly necessary to point out that artificial respiration can be carried out only after the lungs have been inflated. If this has occurred spontaneously, then in most cases respiratory efforts are likely to continue, at any rate in cases of asphyxia livida. If a child is making regular respiratory efforts, even at relatively long intervals, it is better left alone, as artificial respiration may upset the spontaneous rhythm and do more harm than good. Besides, if in the agitation of the moment the person in charge uses more force than is necessary, harm may result. One has witnessed an inspiratory effort checked or frustrated by compression of the chest of the child.

At the moment the treatment which is very much favoured is the administration of carbon dioxide (6 per cent.) and oxygen at a moderate degree of pressure with the object of (*a*) supplying carbon dioxide sufficient to stimulate the respiratory centre, and (*b*) inflating the lungs.

In all large hospitals cylinders of carbon dioxide and oxygen are available. A breathing-bag filled with carbon dioxide and oxygen (6 to 8 per cent. of the former), attached by tubing to a small face mask or intratracheal tube, is a simple outfit. The exit of the gas mixture is controlled by a stop-cock. Twelve to sixteen times a minute the bag is compressed. The tracheal tube is more troublesome than the mask, but it ensures more certain entry of air into the lungs than the mask.

The oldest and simplest insufflation method is mouth-to-mouth. The expired air from the operator contains carbon dioxide and oxygen in suitable proportion and at a suitable temperature. There are, however, several dangers, although all can be avoided by taking suitable precautions. Several layers of gauze placed over the mouth of the child protects the operator from infection. Pressure on the epigastrium of the child prevents the expired air from the operator being forced into the stomach and compression of the child's nostrils prevents its escape by that route. Lastly, if the operator fills out his cheeks, and only permits pressure by his cheek muscles being exerted on the air forced into the child's lungs, there is no risk of a dangerous degree of pressure which might rupture the alveoli of the lungs.

A very simple technique has been recently described by Blaikley

and Gibberd.¹ They use a special pharyngoscope (Down Bros., London). The child is held by an assistant with its head overhanging the table on which it lies. The upper respiratory passages are cleared of mucus and the pharyngoscope introduced over the tongue. If the tongue is pressed forwards the epiglottis moves with it and the vocal cords are exposed. The cords are usually relaxed and offer no resistance to the passage of the catheter. The authors mentioned stress three important points in their technique. *Firstly*, they point out that the intratracheal pressure required to achieve the initial expansion of atelectatic lung—15 to 20 cm. of water—is considerably higher than that required to maintain ordinary respirations in a previously expanded lung, and with a catheter of the size recommended this may call for pressure of 35 cm. of water in the bag from which the gases are delivered. *Secondly*, they insist that the infant must be kept in a slightly inverted position (making an angle of not less than 15 degrees with the horizontal) so that gravity may prevent inspiration of mucus, etc., into the alveoli of the lungs. *Thirdly*, they point out that the *real need is for oxygen*, and the admixture of 5 per cent. carbon dioxide, though useful, is of relatively minor importance in an asphyxiated infant whose tissues contain an excess of this substance. They do not recommend intratracheal insufflation as a routine method, but reserve it for those cases in which simple methods fail to establish respiration, and they also quote cases of partial atelectasis with repeated attacks of cyanosis in which immediate and permanent improvement resulted from insufflation.

A much more elaborate method is the employment of the Drinker apparatus, by which the chest is expanded by establishing a negative pressure (8 to 10 cm. of water).

The observations which have been made with the Drinker apparatus are undoubtedly most interesting, but it is unlikely that so complicated an apparatus will come into general use in hospitals. Besides, it is very questionable if, by negative pressure, as satisfactory expansion of lungs can be established as by direct intratracheal insufflation by positive pressure, which, as we have seen, can be very easily carried out.

Lumbar puncture may be of service in cases of intracranial hæmorrhage and any form of increased intracranial tension, but the prognosis is extremely unfavourable in such cases, and the benefit, if any, is generally only temporary.

It will be observed that no reference has been made to artificial respiration as carried out by the Schultz, Byrd, Marshall Hall or Sylvester methods. All are dangerous (probably the last-mentioned the least so), because they disturb the child. Particularly dangerous is the Schultz method. Not only may it aggravate the lesions responsible for the asphyxia and shock, but the manipulations in themselves may produce additional lesions.

¹ *Lancet*, 1935, vol. i., p. 736.

DISEASES OF THE NEWBORN CHILD

Diseases of the newborn are considered in Chapter XXXVIII, entitled "Health, Nutrition and Disorders of the Newly Born Infant." We think it advisable, however, to draw attention to one or two conditions which require treatment immediately or shortly after the child is born, and which are not referred to in that special chapter.

Ophthalmia Neonatorum.—This serious infection of the eyes of the newborn most commonly occurs in the later stage of parturition, during the passage of the child through the lower vagina and vulvar orifice. In a few cases, however, of prolonged labour where the membranes have ruptured prematurely, the infection may occur whilst the child is still *in utero*. Further, there are a number of cases in which the infection occurs after birth, from the transference of gonococci by the fingers of the mother or nurse, or from clothing, dirty linen, etc. The time of incidence after birth indicates which of these sources of infection is the most probable. In the majority of cases where the infection occurs during the later stages of the labour the disease does not manifest itself till the second or third day, whilst in the examples of intrauterine infection the child may develop symptoms shortly after its birth.

The complication is most serious. Prior to 1880, before the introduction of prophylactic treatment, it was estimated that 40 per cent. of the inmates of asylums for the blind owed their blindness to ophthalmia neonatorum. But matters have become very much better in recent years, *and more especially since every case of conjunctivitis, however slight, occurring within twenty-one days of birth has to be notified.*

To-day the gonococcus is the exciting cause in only about 10 per cent. of cases. Other organisms, *e.g.*, *bacillus coli*, streptococcus, staphylococcus, pneumococcus, are the cause; but the very purulent examples are generally of gonococcal origin.

SYMPTOMATOLOGY.—We have seen that the infection generally occurs at the end of parturition, so that, as the incubation period of the infection is from two to three days, it is not until the beginning of the third day that symptoms manifest themselves. About this time a serous discharge, often blood-tinged, appears. The eyelids then become œdematous and swollen, and within a very short period the discharge becomes purulent. This discharge is liable to be pent up underneath the eyelids, for the lids become adherent from dried-up secretion. If neglected, the ocular conjunctiva, which was at first only slightly inflamed, becomes swollen, œdematous, the cornea becomes opaque, ulcers form, infection of the eyeball occurs, and this may go on to complete destruction. It is of supreme importance, therefore, should the condition arise, that it be energetically dealt with; better still, that every possible precaution should be taken to

prevent its occurrence. The treatment, therefore, may be divided into (a) prophylactic treatment ; (b) curative treatment.

PROPHYLACTIC TREATMENT.—Fortunately, if the treatment to be outlined is followed there is little chance of serious ophthalmia developing. As such excellent results follow this treatment, it has become a routine practice in all obstetric hospitals. It has not yet been so universally employed in domestic obstetric practice, and this is to be regretted.

The credit for instituting preventive treatment for this condition is associated with the name of Credé. It consists in careful sponging of the eyelids and the insertion of one or two drops of a recently prepared 1 per cent. solution of nitrate of silver. No better prophylactic measure has been evolved, although some writers have taken exception to the strength of the silver salt and have suggested weaker solutions. Undoubtedly, catarrh sometimes follows silver nitrate, but that soon passes off and is of no serious consequence. A 1 per cent. solution is sufficient as a prophylactic ; but if the disease is established a solution of 1·5 per cent. strength may be used. It is claimed that the acetate of silver salt is better, as it is more stable and less irritating. Protargol and argyrol, 6 to 8 per cent., have also been employed, but in common with many others we believe that nitrate of silver is better. Very rarely, indeed, does ophthalmia neonatorum develop if the eyelids are carefully sponged with small pledgets of cotton-wool soaked in boracic solution and a few drops of nitrate of silver solution inserted ; *but the drops must be inserted underneath the eyelids*, and not allowed to trickle over the skin. It must be done immediately following the birth of the child, and as a rule need not be repeated.

ACTIVE TREATMENT IF DISEASE PRESENT.—Should the eyes become early infected in a protracted labour or should the prophylaxis already mentioned not be followed or not satisfactorily carried out, the acute infection must be actively dealt with immediately, for every hour lost increases the chance of a corneal lesion, and once the cornea is injured or infected it is impossible to tell how grave may be the consequences.¹

In domestic practice the doctor and nurse should sit facing one another. The child should be wrapped up in a towel with its trunk resting on the lap of the nurse ; its head should be held between the knees of the doctor. It is advisable that both the nurse and doctor wear goggles and rubber gloves, for sometimes when separating the lids a spurt of pus may occur, and nurse or doctor may have their eyes infected. The eyelids, having been carefully sponged with pledgets of cotton-wool soaked in boracic solution, should be carefully separated. It is hardly necessary to use lid retractors, although sometimes it is

¹ The condition may have such serious consequences for the child that, when at all possible, treatment should be carried out in an ophthalmic clinique by experts. Besides it is very difficult for the nurse single-handed to carry out the treatment here detailed.

impossible without them to cleanse thoroughly the cornea and conjunctiva. By means of pipette or douche tube the eyeball and lids are thoroughly washed with boracic solution. The douche nozzle or pipette should not be pushed in forcibly between the lids, as it may abrade the corneal surface. Having washed the eyes, one or two drops of the silver nitrate, protargol, or argyrol solution should be inserted. Every two hours during the day, and several times during the night, the nurse-in-charge should cleanse the eyes in the manner already described. This repeated cleansing is of great importance. The application of the nitrate of silver must not be repeated too often. Usually only one or two applications are necessary. After each treatment boracic ointment should be smeared along the margins of the eyelids so as to prevent them sticking together.

Where the lids are more seriously affected it may be necessary to evert them and paint the surface with a nitrate of silver solution (3 per cent.). In more severe cases, where the cornea is seriously damaged, the routine treatment should be persisted in, and the nitrate of silver continued in a somewhat weaker solution. It is necessary also to put in a few drops of atropin to keep the pupils dilated.

The doctor and nurse-in-charge must ensure that all dishes, cotton-wool, towels, etc., employed are kept entirely for the infant's use, as severe infections to the eyes of the mother or other members of the household might occur if this precaution is not taken.

Sulphonamides so beneficial in the treatment of gonorrhœa have been recommended for ophthalmia neonatorum. Special tabloids (0.125 gm.) of sulphapyridine should be administered every four hours until six tabloids have been given.

Where one eye only is affected, prophylactic measures should be employed for the healthy one, and a dressing applied over it. It is, however, difficult to prevent the other eye becoming infected.

Umbilical Hernia.—The grosser forms and the variety known under the term "exomphalos," where the abdominal contents lie outside the abdomen (p. 505), are easily recognised. It is the slighter forms, where only a small loop of bowel protrudes into the substance of the umbilical cord, which may be overlooked. There have been a number of cases recorded where such a cord, looked upon as simply large and œdematous, has been tied and cut, and it has been found that a loop of bowel has been excised. These small hernias can be easily diagnosed by stripping the cord towards the abdominal opening with the thumb and forefinger, when the bowel is felt to slip back into the abdomen.

The treatment is immediate operation and closure of the patent ring in the abdominal wall. The writer has had a child operated upon within twenty minutes of its birth.

In some of the more pronounced examples of ventral hernia or

exomphalos, a plastic operation at a later date may prove successful in securing a strong abdominal wall.

The most common form encountered is where a small hernia develops some time after the stump of the cord has separated. Very often such a small hernia can be cured by a well-fitting umbilical pad held in position by a rubber belt or strapping.

Umbilical Infection.—Infection of the cord may have very serious consequences, as not only may there occur a cellulitis of the abdominal wall, but extension of the infection along the umbilical vein to the liver. It is quite probable that a number of obscure illnesses in the newborn arise from slight infections of this nature, consequently it is of supreme importance that the umbilical cord after birth should be carefully disinfected and treated with antiseptic dressings until it has completely separated.

The simplest and best antiseptic is methylated spirit. Night and morning the umbilical cord and the area around its attachment should be swabbed with spirit, and when the parts are dry well sprinkled with sterile dusting powder. The cord should then be wrapped up in a piece of sterilised linen or cotton, the dressing being held in place by the abdominal binder.

PART VI
THE PUERPERIUM

CHAPTER XXXVI

NORMAL PUERPERIUM

Involution of Uterus—Lochia—Lactation—Other Features of Puerperium—
Management of Puerperium—Post-natal Examination.

THE puerperium extends from the birth of the placenta until the generative organs have returned to the pregravid condition—a matter of six to eight weeks. The changes are most rapid in the first fortnight of this period.

The three striking features of the puerperal state are : (1) involution of the uterus, (2) the discharge termed the lochia, and (3) lactation.

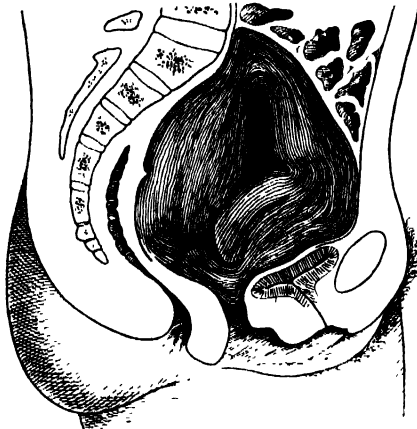
Involution of the Uterus.—This is the process by which the uterus returns to the pregravid condition, shrinking from a sac which is about 7 inches (17·5 cm.) long and weighing about 2 lbs. (1000 grm.) at the end of labour to a small organ 3 inches (7·6 cm.) long and weighing 1 ounce (30 grm.). The uterus never actually returns to the original state ; in a parous woman it always remains a little bigger and more movable than in a nullipara.

After birth the fundus is about the level of the umbilicus—*i.e.* 4 to 5 inches (10 to 12·5 cm.) above the symphysis. During the first twenty-four hours it rises a little ; thereafter the uterus becomes steadily smaller, diminishing at about the rate of $\frac{1}{8}$ inch (·8 cm.) daily. By the tenth to the twelfth day it can no longer be felt in the abdomen. Frozen sections (Figs. 255, 256) made through the puerperal pelvis have demonstrated that the *lower uterine segment* exhibits rapid retrogressive changes ; it can no longer be distinguished by the third day. The cervix shrinks to its minimal size in the course of six or seven days. It never, however, regains its small, conical, pregravid state ; by its permanent increase in size and by the transverse opening out of the external os its parity can subsequently be recognised by vaginal examination. In exceptional cases it may, however, be impossible from a vaginal examination of the cervix to determine that the woman has ever given birth to a child.

The rate of involution of the uterus is usually recorded on the patient's pulse and temperature chart (Fig. 257), the height of the fundus above the symphysis being noted day by day. In making these observations the same hour each day should be chosen, the uterus should be pulled over to the middle line, it should be kneaded till it is in a state of contraction, and the bladder should be empty.

If these details are not followed erroneous measurements will be obtained.

The rapid shrinkage of the uterine wall is chiefly due to autolysis of the muscle fibres, whereby their protoplasm is broken down by proteolytic ferments into soluble end-products which are removed by the blood-stream. As a result of this, peptones are present in the urine of puerperal women and the excretion of nitrogen is greatly increased in the early days of the puerperium. The vessels of the uterine wall become closed by thrombi and undergo degenerative changes and disappear. They are replaced by new vessels which are formed in the organising clot in the lumen of the obliterated vessels. Absorption of the wall of the old vessels is often incomplete and they remain as scattered areas of elastin, which can be recognised

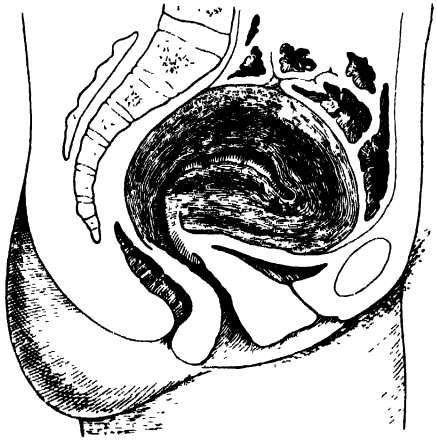


From Barbour's "Anatomy of Labours."

FIG. 255.—Uterus immediately after Labour. Note retracted active contractile portion, lower segment, and cervix.

by their special staining reactions. This appearance is characteristic of the parous uterus, but when these areas are present in excess the condition is known as *subinvolution*. Teacher, who made an exhaustive study of the process of involution, showed that the process was almost uninterrupted by slight infection and may go on in the presence of even severe infection. On the other hand, much delay and great variation in the process of repair can result from the retention of fragments of placenta or membrane.

The placenta separates through the level of the spongy layer of the decidual membrane and the remaining decidua becomes detached during the puerperium and escapes in the lochial discharge. Some of it, however, at the deepest level where it is related to the muscular wall, remains, and from the stroma and gland cells in it the endometrium is regenerated. Except at the placental site, the surface of the uterine cavity is covered with epithelium within a week or ten days and the entire endometrium is



From Barbour's "Anatomy of Labours."

FIG. 256.—Uterus on Fifth Day of Puerperium.

regenerated at the end of the third week. On the other hand, six to eight weeks are required for the disappearance of the placental site. According to Williams this is effected by the new endometrium growing under the edges of the placental site, which is gradually shed into the uterine cavity.

Lochial Discharge.—Lochia.—This is the discharge from the genital tract during the first three or four weeks of the puerperium. It consists of blood and decidual remains, and for the first few days it is bright red. Later it becomes brownish and then yellowish. The duration of the red lochia varies considerably and in the majority of cases it far exceeds the supposed normal time limit of ten days. Besides red blood corpuscles and fibrin the lochial discharge contains leucocytes, decidual débris, vaginal epithelium and peptones. It is alkaline in reaction.

The quantity of the discharge varies in different cases within normal limits. *It is increased* in such pathological conditions as arrested involution, retained portions of membrane or placenta, and where the placenta has been unduly large as in twin pregnancy. *It is diminished* in certain types of puerperal sepsis and in cases of undue flexion of the uterus, either acute anteflexion or retroflexion where the lochia may be pent up (Lochiametra, p. 662).

The lochial discharge is usually sterile as it escapes from the uterus, but in the vagina it becomes contaminated with organisms. It therefore has a characteristically heavy odour. Where uterine sepsis is present, the lochial discharge is usually more profuse and more foetid, except in certain cases of severe sepsis where it is diminished in amount and practically odourless.

Lactation.—During pregnancy extensive growth of the breasts occurs, affecting both the alveoli and the ducts, but secretion is confined to the production of a watery fluid called colostrum (p. 670). Secretion of milk occurs only after parturition and disappears if the breasts are not suckled. The hormones responsible for the changes in the breasts are *œstrin* and *progesterone* from the ovary and *prolactin* from the anterior lobe of the pituitary gland. The ovarian hormones produce hypertrophy and glandular proliferation and prolactin causes the secretion of milk. Lactation does not occur if pregnancy is terminated in the early months or if the foetus dies *in utero*. Therefore there is probably another factor controlling lactation, associated with the growth of the foetus (*vide* p. 128).

The secretion of milk usually appears on the second or third day of the puerperium and may cause sudden engorgement of the breasts, with consequent discomfort and often slight pyrexia. The mechanical stimulus of suckling is the chief factor in the maintenance of mammary secretion (p. 670).

Other Features of the Puerperium.—At the close of a normal labour the pulse is full and moderately slow and the *temperature* usually subnormal. Sometimes slight shivering occurs, without rise of temperature or pulse-rate. If the labour has been prolonged the patient

shows signs of exhaustion and the temperature may be 100° F. or higher. Even after a normal labour the temperature may rise one or two degrees without any unfavourable accompaniments and is probably due to reaction from the muscular fatigue of labour. It falls within twenty-four hours. The temperature should be recorded carefully morning and evening for the first fourteen days of the puerperium. Temporary elevations of temperature may occur in the first week of the puerperium from such causes as engorgement of the breasts, excitement, or bowel disturbance, but any rise of temperature

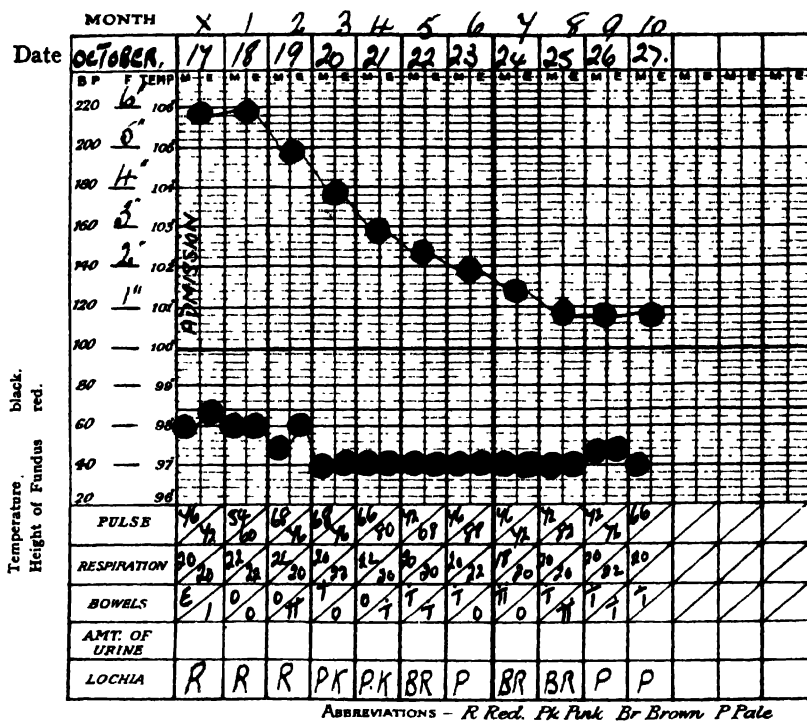


FIG. 257.—Hospital Chart. The red graph represents the involution of the uterus, the black graph the temperature.

above 100° F. should always be regarded seriously and a thorough clinical and bacteriological examination carried out. It is safer to regard such cases as due to puerperal sepsis and keep them isolated until it is proved that infection is not present.

Puerperal pyrexia is now a notifiable condition. For this purpose the Ministry of Health has defined puerperal pyrexia as a rise of temperature within twenty-one days of childbirth or miscarriage to 100.4° F. (38° C.) or more, sustained during a period of twenty-four hours or recurring during that period.

The pulse-rate must be carefully recorded during the puerperium, as it is a more reliable index of the patient's condition than the

temperature. With the reactionary rise of temperature which sometimes occurs after delivery, the pulse-rate remains undisturbed. In cases of sepsis the fever is accompanied by a disproportionately rapid pulse-rate. In cases where there has been severe hæmorrhage or undue exhaustion, the pulse-rate may remain abnormally rapid for several days.

As a rule the patient passes *urine* naturally about six to eight hours after delivery, but there may be difficulty due to various factors, such as nervousness and bruising of tissue round the urethra. There is usually a well-marked diuresis in the first two days of the puerperium after which the amount gradually falls to normal limits. Lactose is normally present in the urine after lactation is established. Peptones are present in small amounts during the first week and are attributed to involution changes in the uterine muscle. Traces of albumen and acetone are frequently present.

The *skin* acts freely and for the first few days the bowels are usually constipated.

Irregular uterine contractions, known as *after-pains*, occur during the first day or two in multiparæ. In primiparæ they are less common and usually indicate retained blood-clot.

The *leucocytosis* which is a feature of pregnancy disappears rapidly during the early stages of the puerperium. A rapid rise in the number of leucocytes indicates the onset of some inflammatory condition.

Management of the Puerperium.—The temperature and pulse-rate should be charted twice daily and the height of the uterine fundus noted daily. The aseptic and antiseptic precautions observed during labour to prevent the entry of pathogenic organisms into the vagina should be continued in the puerperium. It is essential therefore that the *nurse in attendance should wear a mask when the vulva is exposed and sterile gloves* when performing the toilet of the vulva. Sterile perineal pads should be used and burnt as they become soiled. The vulva should be frequently swabbed with antiseptic solution in a downward direction towards the anus, to avoid contamination from the bowel.

After a normal labour the patient should be comfortably supported by pillows or a bed-rest *in a semi-sitting position* with a pillow under the knees. The posture allows free escape of lochial discharge and is an important prophylactic measure against infection. Spontaneous contractions of the uterus occur after labour and help to promote drainage. In primiparæ these seldom give rise to pain, but in multiparæ, where the retraction of the uterus may not be so effective in keeping it empty of blood-clot, the after-pains may be severe. Treatment should be directed to stimulate the uterus to expel the blood-clot by massaging the uterus through the abdominal wall or by giving liquid extract of ergot by mouth in doses of 1 dram, or ergometrine 1 mgm. by mouth or 0.5 mgm. intramuscularly.

Severe after-pains sometimes occur during suckling even where the uterus is well retracted and empty. This is usually relieved by aspirin or a few minims of nepenthe. Recently corpus luteum hormone has been given in such cases to allay the spasm. This preparation is still expensive, however, and the pain is seldom so severe as to warrant its use.

Vaginal douching is unnecessary when the puerperium is normal and may be dangerous if carried out carelessly. If drainage from the vagina is deficient and the lochia very foetid, a gentle vaginal douche may be given, but not before the end of the first week. It is important to have the patient in a semi-sitting position when giving the douche to prevent fluid from entering the uterus. The best solution to use for the douche is Dettol, 1 dram to 1 pint of water at a temperature of 100° to 110° F.

Temporary retention of urine may occur, but before resorting to catheterisation simple measures, such as hot water placed in the bedpan and the vulva bathed with hot antiseptic solution, or the patient gently placed in the sitting or knee-elbow position, should be tried. While catheterisation is to be avoided if possible, one must not delay too long in emptying the bladder, because in the puerperium overdistension of the bladder may occur without causing much discomfort and if not relieved will quickly lead to cystitis. Care must be taken to ensure that the bladder is being completely emptied and if necessary a catheter should be passed to test for "residual urine." Incomplete emptying of the bladder is fairly common in the puerperium, as there is a physiological atony of the bladder musculature and a spasm of the urethral sphincter due to nervousness or injury.

There is a tendency to *constipation* in the puerperium and a daily mild aperient may be required.

The *patient should be kept in bed* until the uterus has sunk below the level of the symphysis pubis and the lochial discharge has ceased to be red, which is usually about the tenth day. Until the uterus is well involuted, that is in about six weeks, the patient should avoid undue exertion to minimise the risk of prolapse or retroversion.

She should be kept quiet in the early puerperium and visitors restricted, as there is a tendency to emotional instability.

She must have *sufficient sleep*, and if necessary mild hypnotic drugs should be given. Calm quiet surroundings and adequate rest and sleep are essential for successful lactation. For the first day or two the diet should be light. Thereafter a normal diet should be quickly restored, combined with an abundance of fluid to promote lactation. A considerable quantity of milk should be taken.

Systematic exercises should be carried out from the second day. They should be carefully graded in some such system as that evolved by Margaret Morris, described in her book "*Maternity and Post-operative Exercises*." Such exercises not only improve the tone of the

overstretched abdominal and perineal muscles, but also aid digestion, lactation and the natural action of the bowel. By improving the tone of the skeletal muscles they ensure proper posture. Massage may also be useful. Permanent loss of tone of the muscles of the pelvic floor is an important factor in the production of prolapse of the vaginal walls and uterus and loss of tone of the abdominal muscles predisposes to displacement of both pelvic and abdominal viscera. Overstretched ligaments and atony of the general musculature cause faulty posture with its resultant ill-health.

Post-natal Examination.—A thorough post-natal examination should be carried out in the *fourth* week post-partum. A general physical examination should include blood-pressure estimations, hæmoglobin estimation if anæmia is suspected, and examination of a catheter specimen of urine for albumen and pus. The perineum and cervix should be carefully inspected and any infection of either treated.

A bimanual examination should be carried out to detect any mal-position or *subinvolution* of the uterus or *any inflammation* of the adnexa. The most common sequelæ, of even normal parturition, are erosion of the cervix and retroversion of the uterus. At this early stage erosion of the cervix yields easily to treatment by cauterisation. In cases of retroversion the position of the uterus should be corrected (p. 57). An anæsthetic is sometimes required for this. A Hodge pessary is inserted and left in position for several weeks, by which time the uterus usually remains in good position after the removal of the pessary owing to the shrinkage of the uterine ligaments in the process of involution. Conditions of sacro-iliac and lumbo-sacral strain due to laxity of ligaments can be most effectively treated at this stage by manipulation, exercises and suitable supports. If untreated, they may cause much disability.

CHAPTER XXXVII

COMPLICATIONS OF THE PUERPERIUM

Puerperal Infection—Extragenital Infective Conditions—Faults in Involution—Other Complications

PUERPERAL INFECTION

OF all the complications of the puerperium none by reason of its frequency and seriousness is so important as puerperal infection. Believed at one time to be a specific fever, and even now referred to as “Puerperal Fever,” it has slowly come to be recognised and accepted as a septic infection of the genital tract by organisms of a similar nature to those found in any septic wound.

To give even a short historical sketch of our slowly acquired knowledge of puerperal septicæmia is impossible in a work of this size. We must, however, make reference to one obstetrician and to the great discovery he made. The name of this great obstetrician is Semmelweis, born in 1818 at Budapest. His great discovery, arrived at by purely deductive reasoning, was made in 1847, when he demonstrated that if the attendant washed his hands with a chlorine solution, puerperal infection could be greatly reduced. Long before Lister, inspired by the experiments of Pasteur, demonstrated the value of antiseptic lotions in surgical practice, Semmelweis had demonstrated their value in obstetric practice. His great work, *Die Ätiologie der Begriff und die Prophylaxis des Kindbettfiebers*, often referred to as *Die Ätiologie*, was published in 1861. It ranks as one of the great monographs in medicine.¹

To-day it is accepted that puerperal fever is a wound infection, and that its seriousness is dependent upon the nature and virulence of the infecting organism and the general and local resistance of the individual to infection. The portals of entry are the lacerations and bruises in vulva, vagina and cervix, caused during labour, and the ragged placental site.

The work of Semmelweis and others has resulted in the disappearance of the bad outbreaks of puerperal sepsis, with death rates of over 50 per cent., which were previously of frequent occurrence in maternity hospitals. Puerperal infection still occurs and causes approximately

¹ *Semmelweis: His Life and His Doctrine*, by Sir W. Japp Sinclair, M.A., M.B., Manchester, 1909.

one-third of the total deaths. The other complications and accidents of childbirth, including abortions (apart from deaths due to sepsis included in all deaths due to sepsis) and known as "Other Causes" account for approximately two-thirds of the total deaths (*vide* Tables, pp. 757, 758). The practical application of recent advances in our knowledge of the ætiology and treatment of puerperal sepsis has led to a progressive reduction in the death-rate from puerperal sepsis in recent years (p. 755).

ÆTIOLOGY

There are three factors to be considered in the ætiology of puerperal infection :—

1. The infecting organism.
2. The source of infection.
3. The predisposing factors.

1. **The Infecting Organism.**—The infecting organisms are the same as those found in other forms of sepsis and can be divided into four groups : (*a*) hæmolytic streptococci, (*b*) anaerobic streptococci, (*c*) other pyogenic organisms and (*d*) certain specific bacteria.

(*a*) **HÆMOLYTIC STREPTOCOCCI.**—These are by far the most important organisms in puerperal infection, especially in the severe forms. They are responsible for about 80 per cent. of the fatal cases. In 1935 Lancefield and Hare showed that hæmolytic streptococci can be divided into eleven well-defined groups (A to K) by serological tests ; and that only those in group A were capable of causing severe infection in the human species. The organisms in group A have certain biochemical characteristics by which they can be fairly easily distinguished, so that it is possible for a bacteriologist to give an accurate report on the presence or absence of group A hæmolytic streptococci within a relatively short time. This is of great importance in tracing the source of infection, and in helping one to assess the prognosis.

(*b*) **ANAEROBIC STREPTOCOCCI.**—This is the next most important group in the causation of puerperal infection, and these organisms were first described by Schottmüller in 1903. More recently, Colebrook has re-emphasised their importance, and has pointed out that infection with anaerobic streptococci occurs much more frequently than has hitherto been recognised. Failure to detect them was due to unsuitable culture methods. Anaerobic as well as aerobic cultures should always be made in cases of puerperal infection.

(*c*) **OTHER PYOGENIC ORGANISMS.**—The organisms in this group may be present in the genital tract without causing any symptoms. *Coliform organisms* cause infections of varying severity in the genital tract, but in most the infection is mild. Infection of the urinary tract in the puerperium is most commonly due to organisms in this group. *Staphylococcus albus* causes relatively mild infection as a rule, but the

Staphylococcus aureus may give rise to fatal septicæmia. Mild infections are often due to *Streptococcus fæcalis* and non-hæmolytic streptococci.

(d) CERTAIN SPECIFIC BACTERIA.—These include the *gonococcus*, *B. tetani*, *B. typhosus*, the *pneumococcus* and *B. Welchii*. Infections due to the organisms in this group are rare.

2. **Source of Infection.**—The infections fall into three groups according to their source: (a) *endogenous*, due to organisms already present in the genital tract; (b) *autogenous*, due to organisms present in some other part of the patient's body; and (c) *exogenous*, due to organisms conveyed to the patient from some source outside herself.

(a) ENDOGENOUS INFECTION.—In from 2 to 3 per cent. of healthy pregnant women hæmolytic streptococci are present in the vagina; but several workers have shown that such women seldom develop puerperal pyrexia attributable to the hæmolytic streptococci in the vagina. Recent advances in bacteriology have made it clear that these streptococci do not belong to group A. The severe forms of puerperal sepsis which are due to infection by group A hæmolytic streptococci should always be regarded as autogenous or exogenous. Infection with anaerobic streptococci, on the other hand, is probably always endogenous: these organisms, which probably originate in the bowel, are found in the vagina in about 40 per cent. of healthy women in the later months of pregnancy. Anaerobic streptococci, unlike hæmolytic streptococci, usually require extensive laceration of tissue before they cause infection. Infection by the other pyogenic organisms is usually endogenous, and only occurs in severer forms where there is extensive laceration of tissue. In the fourth group of specific bacteria, which rarely cause puerperal infection, only the gonococcus is endogenous.

(b) AUTOGENOUS and (c) EXOGENOUS INFECTIONS.—These will be considered together. The possible sources of infection are: (1) the respiratory tract of those in contact with the patient at the time of the confinement—*e.g.* the doctor, nurse, relatives and other members of the household, and the respiratory tract of the patient herself; (2) other septic foci present in the contacts or the patient; (3) dust

Respiratory Tract.—It has been found that from 5 to 30 per cent. of the general population harbour hæmolytic streptococci normally in the nasopharynx. These organisms can be conveyed from this source to the vagina by direct "droplet infection" or indirectly by contamination of hands, instruments and dressings. The variation in the proportion of carriers in the population depends on the season of the year and whether the occupation involves frequency of exposure to infection. Hare has shown that in about a third of these carriers the hæmolytic streptococci belong to group A. Without a systematic bacteriological examination of all possible contacts it must be a matter of chance whether the patient is exposed to infection by group A hæmolytic streptococci or not. It is probably true, however,

that the risk of infection from a symptomless carrier is less than from a contact with clinical signs and symptoms of an acute or subacute infection due to this organism.

In 1928, in this country, Smith and Kinloch proved that the most common source of puerperal infection by hæmolytic streptococci is the respiratory tract of someone in attendance on the woman during labour. Four years earlier (1924) Kanter and Pilot,¹ of Chicago, had directed attention to their bacteriological findings in support of droplet infection. This source of infection, of fundamental importance in the practice of obstetrics, was more fully elaborated and demonstrated by Smith² in his historic monograph. Later, Smith and Dora Colebrook, working independently, traced the source of infection in 80 per cent. of the cases infected with hæmolytic streptococci, which they studied. Dora Colebrook emphasised the fact that in six out of thirty-nine women in her series the organism was derived from the patient's own throat. Septic gums must also be included.

Other Septic Foci.—Group A hæmolytic streptococci are sometimes found in cases of scarlet fever, otitis media, mastoid disease, whitlow and quite trivial infections of skin or throat—conditions which are usually nursed at home.

Dust.—Hæmolytic streptococci can live in a dried state in dust for a considerable period of time. Cruickshank found that the dust of wards where patients suffering from burns were nursed was laden with hæmolytic streptococci, and Whyte found a similar state of affairs in wards where puerperal sepsis cases were being nursed.

Infection with *B. coli* is frequently autogenous, as the skin of the perineum is heavily infected from the bowel.

Infection with *B. Welchii* is autogenous from the bowel or exogenous from dust.

Staphylococcal infections are exogenous in the majority of cases from the respiratory tract or from skin lesions.

3. Predisposing Factors.—(a) GENERAL RESISTANCE.—The general resistance of an individual to a specific infection varies. Some are much more susceptible than others. It is a possession handed down from one's progenitors. It is, however, not constant: age, general health, fatigue, environment, for example, affect it differently. A deficient or unsuitable dietary is probably also a factor (p. 187). Although the influence of these factors is at present indeterminable, they probably play a very important part as regards the degree and extent of the infection.

(b) LOCAL RESISTANCE.—*Vagina.*—Normally the 'vagina is covered by a pavement of epithelial cells. There are no glands. The surface cells are being constantly renewed, and at the completion of labour

¹ *Surgery, Gynaecology and Obstetrics*, 1924, vol. xxxviii., p. 96.

² *Causation and Sources of Infection in Puerperal Fever* Department of Health for Scotland, 1931.

the placenta and membranes forced through the vagina and vulva sponge down the surface of the canal in their descent. The protection afforded by these occurrences is, however, of little importance compared to that furnished by the lactic acid produced in the canal by the presence of particular organisms. Attention was first directed to these organisms by Döderlein in 1892, and since then one in particular has been known as the Döderlein bacillus; it is the most important of the acidophilus group of organisms (lacto-bacilli). The lactic acid produced in the vagina due to the presence of the Döderlein bacillus results from the fermentation of glucose derived from the glycogen in the epithelial cells in the vagina. Glycogen is laid down in increasing quantity in these cells during pregnancy.

"As pregnancy advances there is an endeavour to produce an environment in the vagina which will be inimical to invasion by foreign pathogenic organisms."¹

Or, to quote another authority:—

"This acid concentration to-day is generally regarded as the sovereign prophylactic against the implantation of pathogenic germs."²

There is definite evidence that a high pH concentration (4.5 to 5) in the vaginal secretion destroys the *Streptococcus hæmolyticus*, which, although a most virulent organism, soon perishes if conditions are unfavourable. During labour, however, especially if it is prolonged and the membranes have ruptured, the Döderlein bacillus disappears, or can only be recognised with difficulty, and its activity is inhibited by reason of the hæmorrhagic discharge and escaping liquor amnii, which is definitely alkaline (pH 7). The Döderlein bacillus does not make its reappearance until some days after labour.

Some critics may be of opinion that the importance of the action of the Döderlein bacillus is being stressed, but we are convinced that this bacillus is of enormous importance, and when present in large numbers is associated with a Grade A vaginal flora.

Cervix.—The cervical canal is specially protected during pregnancy by a plug of mucus (*operculum*). This is a most complete protection in primigravidæ, but not so complete in multigravidæ if there have been extensive lacerations of the cervix. Once labour has started and the plug of mucus has been expelled, this protection is removed and organisms readily pass into the lower segment of the uterus.

Defence in the Outer Layers of the Uterus.—It would appear that the reticulo-endothelial cells in the outer layers of the uterus and cellular tissue are another defence against infection. It is only recently that this particular defence has received attention, but knowing as we do that the reticulo-endothelial system and its cells are very particularly concerned with the supply of antibodies, there is every

¹ Cruickshank and Baird, *Ed. Med. Jour.*, 1930, vol. xx., p. 135.

² *Therapy of Puerperal Fever*, Köhler and Ehrenfest, 1925.

reason to believe that they are of considerable importance, and any trauma affecting this system predisposes to severe sepsis.

(c) TYPE OF LABOUR.—After a normal labour where there has been no extensive laceration of tissue, the local protective mechanism is sufficient to prevent infection by the endogenous organisms, which as we have seen are usually of low virulence. On the other hand, hæmolytic streptococci under those circumstances are able to gain an entry and even produce fatal sepsis. In fact, between 80 and 90 per cent. of fatal cases of puerperal sepsis following spontaneous delivery have been found to be due to the hæmolytic streptococcus.

Certain conditions facilitate the invasion of the tissues even by less virulent organisms, the most important being the character of the labour. The chance of organisms being introduced will be greatly increased by a prolonged or difficult labour, especially where there is marked laceration of tissue, by multiple vaginal examinations and by such operative procedures as induction of labour, delivery by forceps, craniotomy, Cæsarean section and manual removal of the placenta.

The general resistance of the patient is also lowered by fatigue, hæmorrhage, shock, previous ill-health and pre-eclampsia. In this type of case where both local and general resistance of the patient is lowered, fatal sepsis is more common than after normal delivery, and may be due to any of the less virulent organisms.

PATHOLOGY AND CLINICAL FEATURES

Cases of puerperal sepsis can be divided into four main categories, according to the particular pathological lesion produced. (1) Local sepsis, where the infection is confined to the vagina, cervix and uterus, or any one of those. (2) Infections of the blood-stream, septicæmia. (3) Peritonitis. (4) Infections extending beyond the uterus to the surrounding structures, for example, the cellular tissue, lymphatics and veins, but not into the general circulation.

The infection may be confined to the uterus for some days and then may spread into the blood-stream. Similarly, in group 4 intermittent invasion of the blood-stream may occur. In group 3 there is frequently also gross infection of the pelvic organs.

Any of the organisms found in cases of puerperal sepsis may cause any of the four types of pathological lesion, depending on circumstances. If the organism is a hæmolytic streptococcus the infection is unlikely to be confined to the uterus. Infections due to coliform, diphtheroid and staphylococcal organisms are almost always confined to the uterus; and they may be present in the puerperal uterus without causing any reaction. Before they can cause infection they require a nidus such as retained membrane or placenta, or blood-clot resulting from faulty drainage from the uterus.

(1) **Local Sepsis** (Puerperal Endometritis and Metritis).—This is the condition formerly called *sapraemia*, but this term should now be

discarded. Lacerations of the posterior vaginal wall and perineum are very common, but usually heal well if carefully cleansed and stitched at the time of confinement. If not properly attended to, or if the general and local resistance is lowered, the wound may not heal well and may become infected by organisms (*puerperal ulcer*). The general disturbance accompanying such infections is usually very slight, but there may be slight rise of temperature and pulse-rate. There may be local tenderness and purulent discharge. Careful swabbing with mild antiseptic solution will usually result in rapid healing of such wounds.

Cervix.—Even after spontaneous delivery the cervix looks œdematous and congested and may show slight lacerations, so that, if general

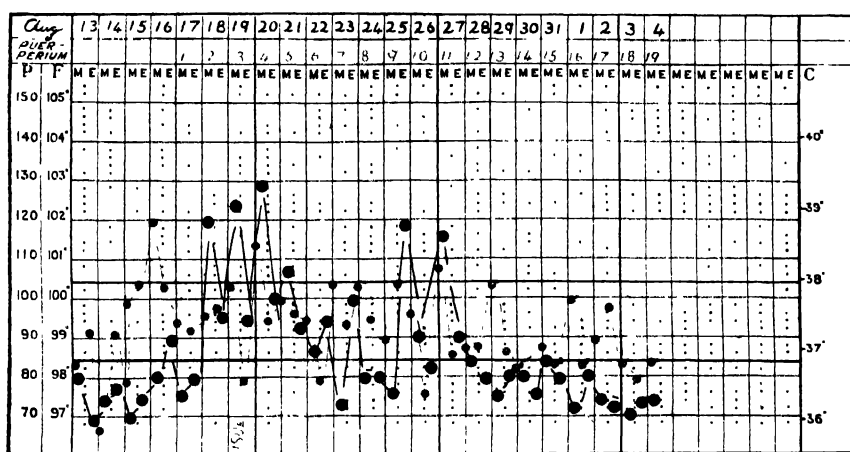


FIG. 258.—Primigravida, married. Albuminuria. Spontaneous delivery. Blood culture negative. Offensive lochia. Chart is typical of local uterine sepsis.

or local resistance is lowered, infection of the cervix may occur. Mild degrees of infection of the cervix without any general disturbance must be very common. If a virulent hæmolytic streptococcus is present, such small lacerations, however, may be sufficient to allow the organisms to gain entry to the pelvic cellular tissue or the blood-stream.

Deep lacerations of the cervix with local sloughing resulting from operative interference before the cervix is fully dilated may result in generalised infection by relatively avirulent organisms. In the practice of good midwifery deep lacerations should not occur.

Uterus.—The appearance of the uterine wall in infection corresponds to that of an infected wound in any other area, varying with different types of organism. In streptococcal infection the wall of the uterus is smooth with little superficial necrosis, whereas in infection with the other less virulent organisms the wall is irregular and shaggy, due to the presence of large pieces of necrotic tissue, consisting of pieces of membrane, placenta or blood-clot, and there is usually a profuse

discharge with offensive odour. The latter type of infection is much more common than the former. Microscopically the uterine wall shows a well-marked zone of leucocytic infiltration below the necrotic layer, known as the *barrier zone* (Fig. 259), whose function is to prevent invasion of the deeper tissues. This barrier zone is effective in localising the less virulent organisms, but it does not prevent the virulent streptococci invading the deeper layers of the uterine wall, where they may spread to the blood-stream or the peritoneal cavity. The muscular wall of the uterus is generally inflamed to some extent in both types of infection and abscess formation may occur, usually in association with infected thrombi in the vessels.

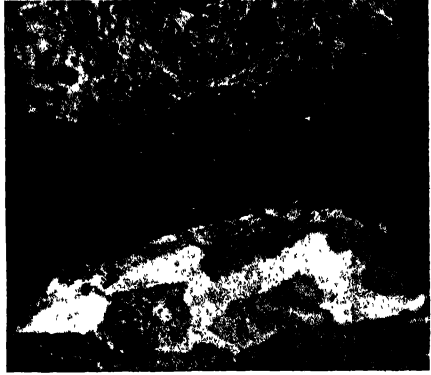


FIG. 259.—Microphotograph of a section of uterine wall from a case of puerperal sepsis, showing the formation of "the barrier zone" of leucocytes in the superficial layers of the muscle.

CLINICAL FEATURES.—In the initial stages these are almost the same, whatever the organism. Infection usually occurs at the time of labour, and there is an incubation period of forty-eight hours; then on the evening of the third day, in a typical case, there is a rise of temperature and pulse-rate, sometimes accompanied by a rigor. Although less common, infection may occur later in the puerperium. The patient complains of headache, sickness and sometimes abdominal pain. The lochia may be diminished in amount in cases of virulent infection, or where there is interference with drainage from the uterus, but otherwise it is increased in amount and offensive.

On examination of the patient the abdomen may be slightly distended and the uterus, larger than would be expected, is usually tender. As soon as there is a rise of temperature in the puerperium a swab should be taken from the cervix to find out whether hæmolytic streptococci are present or not. The bacteriologist should furnish the report within twenty-four hours. The prognosis and treatment depend on the presence or absence of hæmolytic streptococci, and this can be determined bacteriologically much earlier than clinically, and more accurately. By this means the appropriate treatment can be instituted at the earliest possible moment; and precautions taken to prevent the spread of infection to other patients. It is advisable also to have a blood culture done, and a catheter specimen of urine examined bacteriologically to exclude the possibility of infection of urinary tract. In the initial stages diagnosis by clinical means is very difficult, because while as a rule severe infection is accompanied by

acute general disturbance, in some grave cases the onset is gradual and the condition apparently mild in the early stages.

Mild infections with slight general disturbance may result from faulty drainage from the uterus, due either to the recumbent position or to clots of blood in the uterus.

Where the infection is limited to the uterus, suitable treatment usually results in cure in a few days. Sometimes the condition clears up spontaneously after the passage of a piece of membrane which has been blocking the cervix. If the condition is untreated the symptoms may become more severe and generalised infection may result, accompanied by increase in temperature and pulse-rate, sometimes rigors, and on vaginal examination, evidence of extension of the disease to surrounding tissues.

(2) **Infection of the Blood-stream.**—*Septicæmia.*—In most cases invasion of the blood-stream occurs on the second or third day, but may be secondary to local uterine infection and occur about the eighth to the tenth day. *In exceptional cases of prolonged labour a blood infection may occur in the course of the labour.* The temperature rises to 104° or 105° F. and the daily remissions are great. The pulse-rate is also rapid up to 140 per minute, and while it varies to some extent with the fluctuations in the temperature, it remains on the whole more consistently high. The patient's general appearance varies with the amount of fever; she may appear quite well in the morning, when the temperature is usually lower, and very ill at night, when the temperature rises. The evening rise of temperature causes headache, sleeplessness and exhaustion. At the height of the fever there may be delirium, but otherwise the intelligence is little affected except in the terminal coma. Pain is usually absent in the early stages. Joints and synovial sheaths sometimes show serous exudate. Toxic erythematous rashes may appear on the skin, but they disappear quickly. Ulcerative endocarditis, pericarditis, pneumonia, or pleurisy followed by empyema may occur. In those cases the prognosis is very bad.

Sometimes a septicæmia is present from the beginning if the labour has been prolonged, and although the uterus is the site of inoculation it shows little reaction. Such cases are often fatal in a few days.

(3) **Peritonitis.**—When this complication occurs, especially where the delivery has been spontaneous, the organism is usually the hæmolytic streptococcus. The diagnosis of this condition in the puerperium may be extremely difficult. There is continuous vomiting, distension, generalised tenderness and slight rigidity of the abdomen and sometimes diarrhœa. The pulse is very rapid in rate and feeble in quality.

Laparotomy and drainage have been advocated in this type of case, but the results are disappointing. The use of the sulphonamides in the last two years has led to a marked fall in the incidence of puerperal peritonitis and a fall in the mortality.

In a less acute form peritonitis may accompany the lesions described in the next category.

(4) **Infection extending beyond the Uterus to the Surrounding Structures.**—In such cases the infection is seldom limited to a single tissue or organ; for example, in pelvic cellulitis there is usually infection of the pelvic peritoneum and also inflammation of the tubes and ovaries to some extent. The original focus of infection is the uterus from which it spreads through cervical tears into the pelvic cellular tissue. Here it may affect also the lymphatics or the pelvic veins and a phlebitis may develop, which may pass downwards to the femoral veins or upwards into the inferior vena cava. Except where the organism is the hæmolytic streptococcus, extensive laceration of the cervix is necessary in the majority of cases before involvement of the structures in the pelvic cellular tissue takes place. The clinical features of the different conditions in this group are much the same and often do not become defined till the seventh to the tenth day, although before that point there are usually signs of mild infection. Some believe that energetic local treatment with glycerine in the early stages may prevent the infection spreading. The spread of the infection to the structures beyond the uterus is usually accompanied by a rigor and a rise of temperature to about 103° F. The patient complains of severe pain in one or both iliac fossæ. The infection usually persists for a long time and results often in abscess formation. The patient is usually ill and may become very anæmic and debilitated; but death does not often occur. Sometimes the cure is incomplete and the patient may suffer from chronic pelvic sepsis, until uterus and tubes are removed.

(a) **PELVIC CELLULITIS.**—When the cellular tissue is affected a hard, fixed and tender swelling is formed, which may be confined to the parametrium or uterosacral ligaments or may involve the whole of the pelvic cellular tissue. If the cellulitis is confined to one side then the uterus and cervix are usually displaced to the opposite side, but where the cellular tissue is uniformly involved the cervix becomes completely immobile. It may be impossible to decide by bimanual examination whether the veins and tubes and ovaries are involved in the inflammatory process. As a rule the effusion of inflammatory exudate begins to disappear after a week or two. It may go on to suppuration, which is indicated by sharp fluctuations in temperature and sometimes rigors; there is usually also great increase in the amount of pain and tenderness. Fluctuation may be detected and the abscess may point above Poupart's ligament or in the pouch of Douglas or into the rectum. Rarely it may rupture into the bladder. Very occasionally it may pass through the sciatic or obturator foramen and point over the buttock or anterior aspect of the thigh. This particular lesion is more fully dealt with elsewhere.

(b) **SALPINGO-OÖPHORITIS.**—The tubes and ovaries may become

involved in the pelvic inflammation, either by direct spread of the infection from the uterus along the Fallopian tubes or, much more commonly, from the cervix by way of the lymphatic and blood-vessels in the broad ligament. The muscular wall of the tube is therefore more frequently attacked than the lining membrane, so that the inflammation results in a salpingo-oöphoritis rather than a pyosalpinx. The salpingitis is therefore not associated with any discrete swelling and diagnosis is difficult. When the inflammation subsides, the tubes are usually left patent, although there may be kinks and adhesions to the ovary and surrounding structures, which may cause chronic pelvic pain. This is in contrast to the lesion produced in gonococcal and tuberculous salpingitis, where the inflammation affects the lining epithelium of the tubes, so that the fimbriated end becomes sealed and pyosalpinx or hydrosalpinx usually results. Puerperal salpingitis is thus a less frequent cause of sterility than infection by the other organisms (*vide* Sterility, p. 821).

(c) THROMBOPHLEBITIS.—In this form of sepsis the infection is confined largely to the veins, in the first place usually the pelvic veins, but as the result of infective emboli, infection may be set up in the heart, lungs, abdominal viscera and joints. The emboli may vary from small collections of organisms to large infected thrombi. This generalised blood-spread or *Pyæmia* may be late in its appearance and may run a most protracted course. At post-mortem examination of fatal cases, the uterine and iliac veins are found to be much more frequently affected than the ovarian veins. Emboli cause ulcerative endocarditis, abscesses in lung, liver, spleen and kidney, and infection of joints. In many of those cases the organism is an anaerobic streptococcus.

In some cases the infection spreads locally to the veins of the thigh, causing general swelling of the affected limb from the foot to the groin, and this condition is known as *Phlegmasia alba dolens* or "*White Leg*." Two varieties of the condition are described: (1) The *venous type*, in which there is a phlebitis of the external iliac or femoral vein. The thrombosed vein is thickened and tender and can be felt in the upper part of Scarpa's triangle. Sometimes the pelvic veins from which the infection spreads can be easily palpated, but in other cases no clinical evidence of their involvement can be made out. Œdema of the whole limb from the foot to the groin rapidly develops and it is soft and pits on pressure. In some cases only the foot and leg are affected, and this is probably due to organisms circulating in the blood-stream and setting up infection in the distal branches of the large veins. (2) The *lymphatic type*, in which no sign of femoral thrombosis can be detected. The leg is swollen, white and glistening and does not pit on pressure. It is stated that the fluid effused into the tissues is not serum but coagulable lymph. This type is much less common than the venous form.

White leg has a fairly acute onset, about the tenth to the fourteenth day of the puerperium, although it may appear earlier or later. The leg becomes painful and there is a rise of temperature to about 102° F. and a rigor. In the venous form tenderness will be found along the course of the femoral vein often most pronounced in the calf. The left leg is affected more often than the right, and in about a third of cases both legs are affected, the second becoming affected about ten days after the first. The temperature and pulse-rate run an irregular course for about ten days, but the swelling in the leg may persist for a long time. A fatal termination is rare, but pulmonary embolism may occur if part of the clot becomes detached. The chief concern in this condition is not the immediate danger to the patient's life but the possibility that the leg may remain permanently damaged. The patient should be advised to have complete rest until the œdema is gone, as there is a great tendency to a recurrence if the patient becomes overtired.

DIAGNOSIS

Every case of puerperal pyrexia should be investigated carefully and an accurate diagnosis should be established as soon as possible. This involves both clinical and bacteriological examinations. It is wise to assume that the infection is genital in origin, until it has been proved otherwise. It is most important to know at the earliest possible moment whether the infection is due to the hæmolytic streptococcus or not. It is particularly important in hospital practice, since if there is any delay in isolating the patient there is considerable risk of spread of the infection to other patients. An attempt should be made to ascertain the source of the infection to prevent other patients becoming infected. Similar precautions should be taken in private practice also. The bacteriological findings furnish an important guide to treatment and prognosis.

Bacteriological Investigation.—In every area a bacteriological service should be available for practitioners, so that a report of the presence or absence of hæmolytic streptococci may be obtained within twenty-four hours. Where it is indicated, grouping of the streptococci should be carried out.

A swab should be taken for culture from the upper vagina or cervix. *It is unnecessary to take a swab from the uterine cavity.* It is also advisable to have a catheter specimen of urine examined at the same time. In certain circumstances further bacteriological investigation, such as anaerobic as well as aerobic culture of blood and vaginal swabs, should be carried out.

Clinical Investigation.—An accurate temperature chart is essential and accurate notes of the patient's previous health, especially during the pregnancy, are important. The details of the labour, for example, its duration, the number of vaginal examinations, the type of delivery and the nature of any injury should be noted.

As has been pointed out above, in the early stages of infection it is often difficult to determine from examination of the patient the exact nature of the lesion. A general physical examination should be made to exclude any intercurrent disease and the abdomen should then be examined for signs of peritonitis, appendicitis or pyelitis. The uterus should be palpated to detect subinvolution and tenderness. The perineum should be inspected and the cervix inspected through a speculum, but a bimanual examination should not be made at this stage, as too firm pressure of uterus may spread the infection. Later in the puerperium, when the infection of tissues beyond the uterus is suspected, a bimanual examination should be made. The breasts should also be examined for signs of mastitis and the limbs for evidence of thrombophlebitis.

PROGNOSIS

One has to be very guarded in prognosticating the termination in a case of puerperal pyrexia. The strain of the infecting organism is of great importance. If such organisms as *S. hæmolyticus* group A, anaerobic streptococcus, *Staphylococcus aureus* and *B. Welchii* are found in the blood the prognosis is grave; so, too, if the pulse runs very high, rigors are numerous and there is little or no response to treatment by prontosil.

Where the infection is from anaerobic streptococci the illness may be prolonged, sometimes for weeks.

TREATMENT

Prophylaxis.—Any possible source of infection, such as septic teeth or tonsils, in the patient should be eradicated during the pregnancy and her general resistance to infection increased as far as possible by attention to diet and general nutrition. Sexual intercourse should not be permitted for at least six weeks before delivery, and if the patient is being confined at home, the other members of the household should be scrutinised to see that they are not carriers of streptococci. In hospitals the members of the staff should have swabs taken from the nose and throat before being engaged, and if hæmolytic streptococci are found, treatment should be carried out until the nasopharynx is free from infection, and only after this should they be allowed to attend at confinements. In hospital practice, therefore, it should be possible to eliminate sources of hæmolytic streptococci, except those in the patient's throat. The risk of the patient transferring the organisms to the vagina can be minimised by smearing her fingers with Dettol cream, as suggested by Colebrook. In private practice, however, it is more difficult to control the possible sources of infection and more difficult for the general practitioner to keep his nasopharynx free of infection, as he may be attending patients with streptococcal infections. No doctor or nurse should attend a confinement if suffering from sore

throat, common cold or septic wound, even although in many of those cases the organism is not a hæmolytic streptococcus. An efficient mask should be worn by the attendant during the labour and for the first ten days of the puerperium when the perineum is exposed. As every additional line of defence is valuable, antiseptics should be used for the hands and the vulva, and for this purpose 30 per cent. Dettol cream has proved very efficient. The cream is superior to the solution as it remains longer in contact with the tissues (p. 402). In the conduct of the labour it is important to avoid unnecessary trauma, which predisposes to infection and allows massive invasion by the organisms through the extensive lacerations. It is important to repair all lacerations carefully at the time of delivery.

It is doubtful if the use of the sulphonamides used as a prophylactic is of much value.

Nursing, General Medical and Local Treatment.—In all forms of puerperal sepsis good nursing is most important in order to conserve the patient's strength. A bright, well-aired room is a great advantage. The patient's appetite should be stimulated and an abundant, light, easily assimilated diet provided, containing milk, eggs and fruit. A preparation of vitamin A, such as Adexolin, should be given. The patient should be encouraged to drink large quantities of fluid, and in cases where the patient is severely ill and vomiting is a feature, rectal salines containing glucose should be given. Sleeplessness should be controlled by hypnotics, but morphia is seldom required, as it is unusual to have much pain.

Pyrexia should be treated by frequent tepid sponging, but antipyretics are seldom advisable. If the bowels are constipated, a mild aperient or an enema should be given. Occasionally diarrhoea may be troublesome and this is best controlled by starch and opium enemata. The abdomen should be palpated frequently to detect overdistension of the bladder, which is common in cases where there has been much bruising of tissue, and which may give rise to considerable discomfort. If the pyrexia persists, a general as well as a local examination of the patient should be done at frequent intervals to detect any complication which may have arisen.

As most of these patients are anæmic, iron should be given, and where the anæmia is severe or does not respond to iron, blood transfusion may be very valuable in increasing the patient's resistance. Natural resistance to infection varies greatly in different individuals.

FREE DRAINAGE FROM THE UTERUS.—It is most important that the lochial discharge should drain away satisfactorily and this may be prevented by the collapsed lower uterine segment or by plugs of membrane or blood-clot. Fortunately such obstruction can usually be overcome by simple means, such as encouraging the patient to move about in bed and to perform post-natal exercises. The uterus can be stimulated to contract by putting the baby to the breast, massaging

the fundus of the uterus or by giving pituitrin hypodermically or ergot hypodermically or orally—the well-known liquid extract of ergot in 3i doses is effective for this purpose.

If the uterus remains unduly large and bleeding occurs with uterine colic, this may indicate a retained portion of placenta, and exploration of the uterus may be necessary. This should be done with extreme care, and no attempt should be made to disinfect the uterine cavity. Any attempt to do this or to remove the infected decidual lining of the uterus by means of a curette will do more harm than good. The curette will destroy the protective leucocyte zone in the superficial layers of the uterine wall and will open up blood and lymphatic channels through which infection will become generalised. The use of the curette in puerperal infections cannot be too strongly condemned. The uterus should be explored very gently with the finger and any retained portions of placenta or membrane removed, but the decidual lining should be left intact.

If despite the simple treatment outlined above the pyrexia persists, the uterus remains enlarged and tender and the lochia scanty, the most efficient method of securing adequate drainage is by the intrauterine injection of glycerine, originally advocated by Remington Hobbs. A wide rubber catheter is very gently introduced into the uterus and from 10 to 20 c.c. of sterile glycerine is slowly injected three or four times a day, for one or several days according to circumstances. It is believed that the effect of the glycerine is to stimulate a flow of lymph from the wall of the uterus and to encourage uterine contractions. Any pus in the uterus drains through the catheter. There is a great deal of difference of opinion as to how often this treatment is necessary. Its advocates believe that the early use of this treatment will prevent infection spreading to the surrounding tissues, whereas others believe that there is a danger of introducing infection from the vagina, and that the treatment should be reserved for special cases. Where the infection has already extended beyond the uterus, glycerine treatment is not indicated.

CHEMOTHERAPY.—Many chemical substances have been tried orally, intramuscularly and intravenously in the treatment of puerperal sepsis. Benefit in individual cases has been reported with such substances as mercurochrome, eusol, acriflavine and arsenical preparations; but they diminish the natural bactericidal power of the blood and as a rule only kill the infecting organisms when in such a concentration as to be very harmful to the patient. In 1935 Domagk, in Germany, reported that a substance subsequently known as *Prontosil* could protect mice very completely against streptococcal infection. This drug (the hydrochloride of 4-sulphamido-2:4-diamino-azobenzol) by mouth, and *prontosil soluble* (the disodium salt of 4-sulpho-amidophenyl-2-azo-7-acetylamino-1-hydroxynaphthalene-3:6-disulphonic acid) by intramuscular injection were given an extensive trial by

Colebrook and Kenny in hæmolytic streptococcal infections of the puerperium, with startling results. The mortality rate in a series of cases treated was 4·7 per cent. and the average death-rate for the previous five years in similar cases was 22·8 per cent. Originally in the severe cases prontosil was given intramuscularly as well as by mouth, but it has been found that the drug is just as efficacious in the severe cases when given only by mouth.

These results have been confirmed both in this country and abroad. Puerperal sepsis forms numerically the most important component of

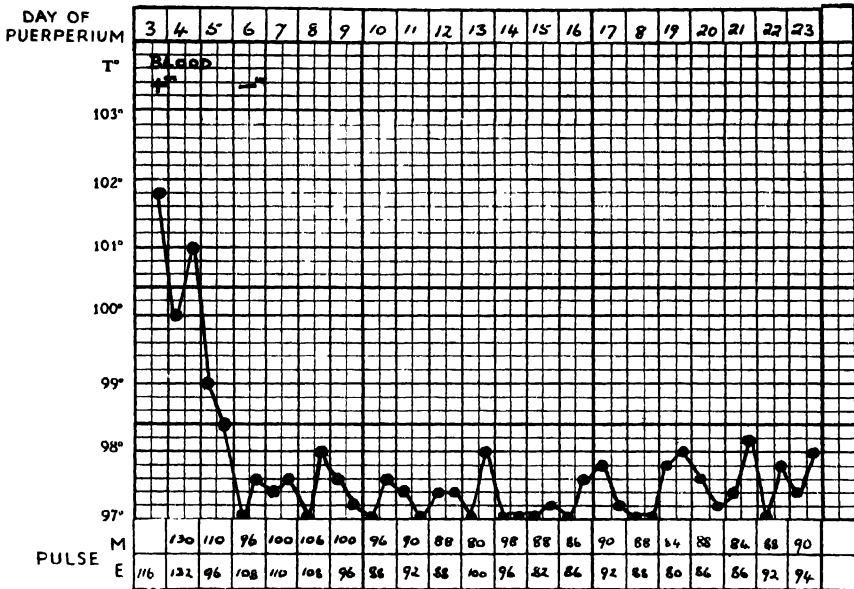


FIG. 260.—The chart of a primipara who on the third day after spontaneous delivery developed a temperature of 102° F. Blood culture gave a profuse growth of hæmolytic streptococci (Group A). She was treated with prontosil (15 gr.) four-hourly and the temperature settled very quickly, and blood culture became sterile.

puerperal deaths. In the ten years from 1928 to 1938 40 per cent. of the total maternal mortality was attributed to this cause. Since 1936 there has been a steady fall, and the death-rate from sepsis for the years 1940 and 1941 was less than half that of the previous ten years. Infections due to hæmolytic streptococci respond most satisfactorily, so that in some areas there have been no puerperal deaths from this organism for several years. Since the original substance known as *Prontosil* was introduced, many more substances, some derived from the original and others similar in composition, have been manufactured, and they are known collectively as the *sulphonamides*. Three substances are now in common use in the treatment of puerperal sepsis—they are sulphanilamide, sulphapyridine and sulphathiazole. These are scientific synonyms, since the chemical formulæ are very long, often occupying a line of print.¹

¹ A very complete summary on the sulphonamides is contained in *The Medical Use of Sulphonamides*, Medical Research Council War Memorandum No. 10. Published by His Majesty's Stationery Office, 1943. Price 9d.

In cases infected with hæmolytic streptococci, sulphanilamide should be used, and it is important to give adequate doses and to start treatment as early as possible after the temperature rises, while waiting for the bacteriological report. Even when the case is one of septicæmia the oral route is effective; 2 grams should be given as the initial dose, after which 1 gram should be administered four-hourly until the temperature has settled for twenty-four hours; the amount should then be reduced to 1 gram eight-hourly for four days, following which the drug should be stopped. Where the infection is due to some other organism, sulphapyridine or sulphathiazole should be substituted

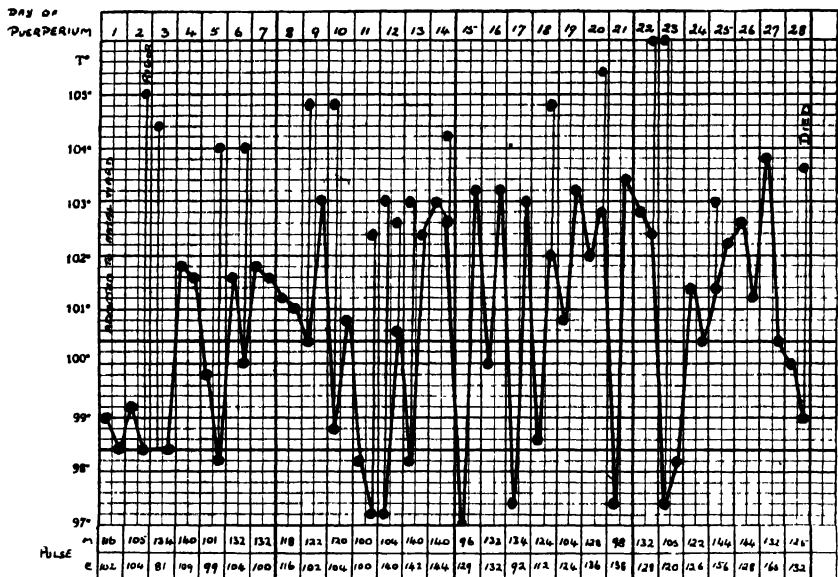


FIG. 261.—The temperature chart of a primipara who had a placenta prævia. Delivery was spontaneous after puncture of the membranes. On the second evening she had a rigor and the temperature reached 105° F. Blood culture gave a profuse growth of anaerobic streptococci. Patient died after four weeks' illness. Large doses of prontosil had no effect.

for the sulphanilamide. There is no clear evidence that either anaerobic streptococci or staphylococci¹ are affected by any of the sulphonamides, but it is generally agreed that sulphapyridine and sulphathiazole affect a wider range of organisms than sulphanilamide. If the temperature does not settle in five days of full dosage the drug should be discontinued temporarily. Although there seems little point in giving sulphanilamide prophylactically in every midwifery case, it is probably wise to give sulphapyridine or sulphathiazole in 1 gram doses four times daily for three days when there are factors predisposing to sepsis. If the patient's condition is poor, due to exhaustion or vomiting, it

¹ For this particular infection it is claimed that this new drug, Penicillin, has potentialities. At the moment no definite pronouncements on its usefulness can be made.

may be inadvisable to give sulphonamides prophylactically because of the tendency to produce depression and vomiting. Vomiting may be controlled to some extent by giving luminal in doses up to 3 grains, by intramuscular injection if necessary. Abundant fluids are essential, and this is of particular importance in dealing with sulphathiazole and sulphapyridine. Cyanosis is common and is not of much importance. Skin rashes are seen; they are most commonly found in the region of the knees and elbows and are usually urticarial in type. A rise of temperature and pulse due to the drug is not uncommon, and the temperature may rise as high as 102° F. or more, with a pulse-rate of 140 per minute. The condition may be difficult to distinguish from a recrudescence of the infection. The symptoms subside quickly, however, when the drug is stopped. Hæmaturia is now established as an important complication of treatment. In the early stages hæmaturia is microscopic only and pain is sometimes present; in the second stage hæmaturia is gross and usually accompanied by pain, but clears up quickly on withdrawing the drug and giving ample fluids. In the third stage there is impairment of renal function which may lead to nitrogen retention, anuria and death. In the third stage with anuria, ureteric catheterisation has proved very valuable. Abundant fluids should always be given while the patient is receiving sulphonamides—a total of 5 pints in twenty-four hours should be aimed at. Fatal cases of leucopenia and agranulocytosis have been reported, but these conditions do not usually develop until between 40 and 50 grams of the drug have been given. If more than that quantity has to be given, leucocyte counts should be done every two or three days.

The value of early treatment with adequate dosage has been stressed, because if there is delay the infection may spread into the cellular tissue or veins and cause abscess formation locally or in other areas of the body. Where this happens, the response to sulphonamides is poor. The need for expert nursing is still as great as ever, and blood transfusion should be given if the hæmoglobin falls to 40 per cent. There should be no relaxation of the prophylactic measures which aim at preventing the patient from becoming infected.

Treatment by Sera.—The treatment of streptococcal infections with antistreptococcal sera has been on the whole disappointing. Specific sera are difficult to prepare and are of very doubtful value. Some believe that streptococcus antitoxin (scarlatina) is of value in overcoming the toxæmia and allowing the natural defences of the body to combat the organism, while others hold the view that this scarlet-fever antitoxin is effective only against the *erythrogenic toxin* and therefore is of little or no use in fevers without a rash.

TREATMENT OF THROMBOPHLEBITIS.—This consists chiefly of immobilisation of the limb in order to prevent pulmonary embolism due to detachment of a portion of the clot. The foot is raised on pillows to promote the venous circulation and the leg is usually wrapped

in lint. Sometimes preparations of ichthyol and glycerine or belladonna and glycerine are applied to the leg. In the early stages when pain is troublesome, morphia may be necessary. No voluntary movements are allowed until the temperature has been normal for ten days or so and the pain has disappeared. The swelling may return when the patient walks, and she may be incapacitated for many months because of this. At this stage gentle massage may help to decrease the swelling.

In cases where there is extensive pelvic thrombophlebitis, attempts have been made to limit the spread of the infection by ligating or excising the affected veins. It is difficult to recognise the condition by vaginal examination, however, and the operation is a very severe one to undertake in a patient who as a rule is not in good condition.

TREATMENT OF LOCAL PELVIC INFLAMMATION.—Where there is inflammation of the pelvic cellular tissue sufficient to cause a palpable mass, local treatment should be carried out. In this type of case, even when the infecting organism is a hæmolytic streptococcus, the response to treatment by prontosil is unsatisfactory. Heat should be applied to the abdomen in the form of antiphlogistine or electrically heated blankets, and to the vagina by hot vaginal douches or by means of the Elliott apparatus. By this latter method water is gradually heated to 130° F. and is made to circulate through a rubber vaginal bag which fits round the cervix. Careful watch should be kept for signs of pus formation, usually denoted by swinging temperature and increased pain and tenderness. The pus should be evacuated either through the posterior fornix or above Poupart's ligament, depending on where the abscess points.

These cases with pelvic inflammatory masses usually need many weeks of treatment in bed, and it is most important to improve the patient's general condition by diet and careful nursing. Treatment should be continued until the blood sedimentation rate is normal, and the prognosis is good if the patient will co-operate by remaining in hospital until the inflammatory process has completely subsided and the blood hæmoglobin is again normal.

EXTRAGENITAL CAUSES OF PUERPERAL PYREXIA

It is hardly necessary to point out that the puerperal woman is just as subject to any infective disease as the ordinary individual. For the most part these diseases present the features peculiar to each, and should therefore be easily recognised. Owing, however, to the fact that the commonest infection in the puerperium is an infection of the uterus, these other infective conditions may be overlooked and the disturbances present attributed to uterine infection. This will become clear from reading the summaries of the various infective conditions which we here record.

Mastitis.—Inflammation of the mammary gland occurs fairly commonly early in the puerperium, about the sixth day. The pyogenic organisms, usually *Staphylococcus aureus*, gain access to the glandular tissue through cracks in the nipple. It has been shown that in the milk ducts different types of organisms flourish, but only cause inflammation when there is a wound of the surface. The physiological engorgement of the breast does not of itself cause inflammation, although it may be accompanied by a slight rise of temperature. Mastitis is ushered in by a sharp rise of temperature, with redness and severe pain in the affected breast. Sometimes the affected area is wedge-shaped with the apex towards the nipple, or there may be diffuse redness of the whole breast. Pus-formation is attended by constitutional disturbance, and softening of the inflamed area with œdema of the skin. In very superficial abscesses near the nipple the pus may discharge through the milk ducts and the abscess undergo spontaneous cure. Sometimes both breasts are affected, the second some days after the first, probably by contamination.

TREATMENT.—Prophylaxis consists of proper management of the breasts during pregnancy and the early puerperium. Cracks in the nipples should be promptly treated. If the mother does not suckle the child, the nipple should be carefully cleansed, the breasts tightly bandaged and a saline aperient given for the first two or three days. If this does not arrest the activity of the breast, ovarian hormone, 10,000 units (1 mgm.) every day for three days, should be given. When there is any sign of inflammation, suckling should be stopped from the affected breast and hot fomentations applied. Saturated solution of magnesium sulphate in the form of a compress is most effective (p. 676). The bowels are kept loose with saline purgatives. Incision of the abscess should be delayed until there is fluctuation and the pus is obviously near the skin surface. The incision should be made parallel to the milk ducts which converge upon the nipple, and should be large enough to allow a finger to be inserted so that pockets can be opened up and drainage established. A rubber drain or a gauze strip should be inserted to prevent the edges of the wound closing too quickly. As a rule rapid healing follows the evacuation of the pus. The amount of gland substance destroyed is not usually very great, and in another pregnancy the gland may function normally. Occasionally the gland is so disorganised by multiple abscesses that complete removal may be the most satisfactory method of treatment.

Infection of the Urinary Tract.—The subject of pyelitis and cystitis in pregnancy is fully considered elsewhere (p. 262). Pyelitis in the puerperium accounts for about 10 per cent. of the cases of puerperal pyrexia and is usually due to infection by a coliform bacillus. The infection may be a "light up" of a pyelitis in pregnancy or may originate during or subsequent to labour. Infection of the urine in the puerperium is fairly common, probably due to incomplete emptying

of the bladder which is particularly liable to occur after an instrumental delivery. While it is not desirable to pass a catheter in the puerperium, probably more cases of urinary infection result from overdistension of the bladder than from catheterisation. As long as the infection is confined to the bladder there is little or no pyrexia, but in some cases the upper urinary tract, including the kidney, becomes involved, probably by direct spread along the lumen of the ureter, and this is accompanied by marked pyrexia. This extension of the infection to the upper urinary tract occurs about the eighth to the tenth day of the puerperium and may be accompanied by pain in the costovertebral angle. This lasts for only a few hours and thereafter pyrexia is the only symptom. The diagnosis is established by the presence of pus in the urine and the absence of any sign of pelvic sepsis.

The infection responds satisfactorily to treatment, which consists of daily catheterisation to ensure that the bladder is being completely emptied and, if the infecting organism is a coliform bacillus, the administration of sulphanilamide, 0.5 grams three times a day.

Tonsillitis, Naso-pharyngeal Catarrh.—Outbreaks of these conditions are liable to occur in the winter months. In hospitals they are a special source of danger. They may be introduced into such institutions by doctors, nurses, patients, or visitors.

A patient suffering from tonsillitis or a naso-pharyngeal catarrh must receive very special attention. In hospital she must be isolated. She must be very specially warned that on no account is she to touch the vulva with her hands, which may be heavily infected with *Streptococcus hæmolyticus* from the discharges in her throat or naso-pharynx. In cases of this nature it is most important that there should be no exploration of the uterus or vagina unless there are very definite evidences of intrauterine infection, as organisms localised in the vagina or vulva may readily be carried up into the uterus and the patient's condition rendered much more grave.

Appendicitis.—Appendicitis as a complication of pregnancy has been already described (p. 241). It sometimes happens that the disturbances of parturition light up a chronic appendicitis, or that an acute appendicitis develops in the puerperium. If so, the ordinary symptoms of appendicitis—pain, tenderness, rigidity, sickness, rise in temperature, and also rise in pulse-rate—develop. Dealt with promptly by abdominal section the results are satisfactory. What is apt to occur, however, in practice is that the symptoms referred to are looked upon as indicating uterine infection, and that either intrauterine treatment is instituted, or the person in attendance waits to see if matters become worse. A mistake in diagnosis is naturally most liable to occur if the attack occurs in the early days of the puerperium.

The treatment of the condition is immediate operation, but if drainage of the pelvis is necessary this should be done through a counter-opening in the lumbar region. Vaginal drainage is naturally contraindicated.

Specific Fevers.—It is quite impossible in a work of this kind to discuss the specific fevers which may complicate the puerperium. The real difficulty in most instances is deciding whether the condition is an example of any one of the specific fevers or is due to septicæmia.

Scarlet Fever.—For generations it was thought that this specific fever could cause a genuine septicæmia in the puerperium with all the ordinary symptoms of puerperal septicæmia, and so it was considered specially grave if puerperal women contracted this fever. There is now evidence in support of this contention. Puerperal women should certainly be carefully guarded against exposure to this infection.

Enteric Fever.—Puerperal septicæmia is often associated with symptoms very similar to those of enteric fever, such as abdominal distension, diarrhœa, enlargement of the spleen, etc. Fortunately, however, we have now the Widal test, by means of which we can say with certainty whether the condition is puerperal septicæmia or enteric.

Diphtheria.—This is naturally a very grave complication of the puerperium. Occasionally cases are encountered in which a diphtheritic membrane is present in the throat, when it is difficult to determine whether it is a true diphtheria. In such cases swabs should be taken from the throat and sent to a bacteriologist for report.

Pneumonia.—This is a very grave complication of pregnancy and the puerperium, especially when it occurs during an epidemic of influenza. In the later stages of septicæmia a septic pneumonia is not uncommon; the prognosis in such cases is extremely grave.

Influenza.—During grave epidemics of influenza large numbers of puerperal women succumb. In most instances this is due to direct pulmonary infection, but in a few there are no evidences of pulmonary complications, the infection being confined to the parturient canal. In such cases the patient may have infected her genital tract with her hands.

Tetanus.—This is a very rare complication. As the organisms may grow and develop in any wound it is not necessary that they be actually introduced into the uterine cavity, a small perineal wound is quite sufficient, and is generally the portal of entry. Recognition of the condition and its treatment in the puerperium is the same as in any ordinary example of the disease.

Whenever recognised, tetanus antitoxin should be immediately given.

FAULTS IN THE INVOLUTION OF THE UTERUS

Subinvolution.—Next in importance to puerperal infection, and very frequently the result of infection, is a condition of the uterus in which it remains more or less permanently enlarged. To this condition is given the name “subinvolution.” We shall discuss later (p. 924) a chronic condition of this nature termed “chronic

subinvolution," or more frequently "chronic metritis"; but for the present we are only concerned with this unsatisfactory involution during the puerperium, or what might be termed "acute subinvolution."

During pregnancy the whole uterus enlarges, and all the tissues take part in this enlargement. We have already seen (p. 122) the effect on the muscle fibres, and that the fibrous tissue between the muscle fibres and around the blood-vessels increases. But we must direct special attention to the behaviour of the elastic tissue not only amongst the fibrous bundles, but also very specially in the blood-vessel walls. The blood-vessels, as we have seen, become enormously enlarged and dilated, more particularly at the placental site.

In the puerperium there occurs first of all a thrombosis of these large blood-vessels. There is always, however, a certain retardation of the absorption of elastic tissue. Further, there arises later in many of these thrombosed vessels a development of new vessels. The special feature of subinvolution is not only a relatively greater amount of muscular and fibrous tissues but a superabundance of elastic tissue around the old and many of the new-formed arteries. This occurrence explains the symptom so commonly present—viz., excessive hæmorrhage.

Symptoms.—Should involution be unsatisfactory, there is generally a continuance of a bright red discharge and the uterus remains enlarged. It is usually uniformly enlarged, and continues to be of a softer consistency for a considerable time owing to overcongestion. It may be to a slight extent tender to pressure, and owing to its weight it very often slips into a position of retroflexion.

Differential Diagnosis.—Few conditions simulate subinvolution, but a diffuse fibromyoma of the uterus and "lochiametra" as they are associated with an enlargement of the uterus, may require to be differentiated.

As regards fibromyoma, the enlargement of the uterus is generally irregular, and very frequently there is more than one tumour present.

Lochiametra, also associated with enlargement of the uterus, immediately disappears if an intrauterine douche-nozzle is introduced and the cavity washed out (p. 662).

Ætiology.—Of all the causes which favour subinvolution none is more important than infection. This infection need not be of a gross nature; it may be so slight and associated with so little disturbance that it escapes notice.

A second very important cause, and sometimes associated with sepsis, is retention of portions of placenta and membrane. If these two conditions can be prevented subinvolution rarely occurs.

Another condition which must be mentioned is retroflexion of the puerperal uterus, referred to later (p. 663). This unsatisfactory position which the puerperal uterus so readily assumes, although sometimes the result, is in a number of cases the cause of minor

degrees of subinvolution. It is of supreme importance, therefore, that this displacement should be corrected as soon as recognised.

We very much question if there is any proof that coexisting ill-health or superimposed diseases can cause subinvolution; they may indirectly favour it, for they undoubtedly lower resistance and increase the risks of puerperal infection.

But there is one other condition which certainly favours subinvolution—viz., repeated pregnancies at short intervals. The uterus normally takes several weeks to involute, and indeed quite probably six or seven months at least elapse before it is absolutely completed. Therefore, if prior to this taking place another pregnancy occurs, there almost of necessity results a pronounced degree of subinvolution of the chronic type.

Treatment.—The treatment of this so-called “acute subinvolution” is most important, for a chronic subinvolution once established is extremely difficult to cure.

The prophylactic treatment of subinvolution is the proper management of labour—viz., the prevention of infection, the prevention of any retention of membranes or placenta, the repair of any injury to cervix or perineum, and manual replacement followed by the introduction of a pessary about the seventeenth or eighteenth day of the puerperium if there is any tendency to retroflexion.

If in spite of every possible care and attention to the details referred to involution continues unsatisfactory, the patient should be given a hot vaginal douche (temperature 110° to 112° F.) morning and evening, and full doses of ergot, in the form of the liquid extract or ergotin pills. On the whole, the fresh liquid extract (1 dram morning and evening) is the better. Pituitary extract is not suitable for continued use, but three or four injections of $\frac{1}{2}$ c.c. may be given morning and evening.

It is unnecessary to state that everything should be done to improve the general health by suitable diet, tonics and regulation of the bowels. The tonics which are most useful are of the type of Easton's syrup and syrup of the iodide of iron; the latter is particularly beneficial.

As already mentioned, the condition of chronic subinvolution or metritis is referred to later (p. 923).

Superinvolution.—It *very occasionally* happens that the other fault in involution—viz., an involution beyond the normal—occurs. This is designated “superinvolution,” “hyperinvolution” or “uterine atrophy”—it is also referred to in the gynæcological section (p. 780).

The ætiology of this condition is now much more fully understood than formerly, in this country largely due to the investigations of Sheehan, who showed that postpartum ischæmic necrosis of the anterior pituitary gland is of relatively frequent occurrence. It is caused by collapse of the patient, usually as a result of hæmorrhage, at or about

the time of delivery. It can be found pathologically in its early stage if the patient dies in the puerperium and in its healed stage if death occurs some years later. If the patient survives the puerperium, clinical evidence of pituitary insufficiency may develop subsequently. This can be of any degree of severity from general debility with superinvolution of the uterus to its most extreme form, the cachexia known as Simmonds' disease. In following up a large series of patients who had had collapse at the time of labour, Sheehan found such symptoms as lack of mammary reaction—*i.e.* no sign of lactation in the puerperium, absence of or infrequency of menstruation, hypersensitivity to cold, asthenia, apathy, loss of libido, loss of weight, loss of body hair and, on bimanual examination, genital atrophy.

In view of the pathological changes produced in the anterior

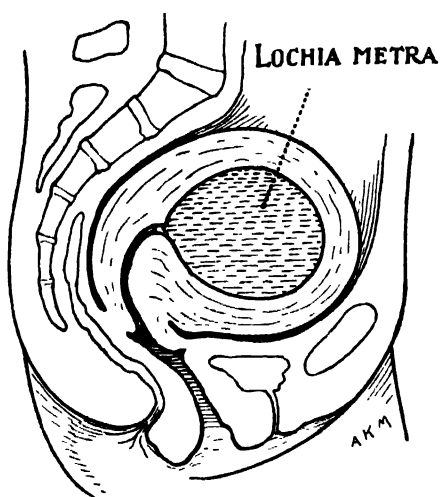


FIG. 262.—Lochiametra with Anteversion.

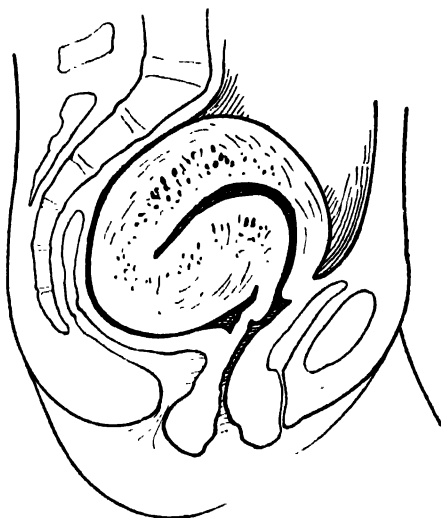


FIG. 263.—Retroflexion of Puerperal Uterus.

pituitary gland, it is difficult to believe that any treatment would be effective.

Lochiametra.—This term is applied to retention of the lochia in the uterine cavity, and is specially prone to occur at the end of the first week when the uterus has partially involuted. It is almost invariably caused by a displacement of the fundus, and most commonly a forward displacement. The condition is generally associated with a certain degree of abdominal discomfort and a slight rise of temperature and pulse, and so it simulates a true infective condition.

It is easily recognised, for the bulky anteflexed uterus can be palpated bimanually as an elastic swelling.

The treatment is simple. An intrauterine douche-nozzle—*e.g.* Fritsch-Bozeman catheter—should be passed through the cervix, and the cavity washed out with normal saline solution or a drainage tube inserted (p. 566). Pituitary extract and ergot should be administered.

Retrodisplacement of the Uterus.—Retrodisplacement of the uterus is a very common occurrence in the puerperium. So important is it that this displacement should be early recognised that all teachers of obstetrics advocate the examination of puerperal women about the sixteenth or seventeenth day, and the insertion of a pessary after manual replacement should a displacement exist. This may be termed the *prophylactic treatment for backward displacement* (p. 852). If followed, there would be comparatively few examples of chronic retrodisplacement of the uterus. The pessary should be worn for three months (p. 637). *It is only in such circumstances that pessary treatment can cure a backward displacement.*

Pulmonary Embolism.—This complication usually occurs after the first week of the puerperium, and results from detachment of a thrombus from the pelvic veins. The clot is carried to the right heart, and from there proceeds to the pulmonary artery. Very frequently it is preceded by thrombosis in the limbs, but in many instances there are no evidences of such a complication—the disaster occurs as a bolt from the blue.

The symptoms of acute pulmonary embolism are very characteristic—the patient complains of sudden and acute precordial pain, dyspnoea, and becomes livid. Death generally occurs within a few hours, but it may be only a matter of a few minutes. Occasionally the patient recovers, although this is rarely observed except where the thrombus is of small size and obstructs only a very small branch of the pulmonary artery. In these slighter cases there may be evidences of localised respiratory disturbances in the area affected.

Very little can be done for this condition in its graver form. If the patient does not die immediately distress may be mitigated by small doses of morphia and inhalations of oxygen. It may be necessary also to give her stimulants by the mouth, strychnine hypodermically and rectal saline infusion. The salts of ammonia are supposed to be of special benefit.

Nervous System.—*Puerperal Insanity* (p. 256).

Neuritis.—We have already seen that neuritis, more especially peripheral neuritis, is an occasional manifestation of toxæmia during pregnancy (p. 253).

The neuritis we are here concerned with is that which occasionally follows injuries to the maternal structures during passage of the head through the pelvis. Not only may there be pain, but there may be a severe neuritis, with paresis of the muscles of the leg. This is invariably unilateral, and affects most commonly the external popliteal nerve.

In other cases the neuritis is caused by pelvic infection, more particularly of the cellular tissue of the pelvis.

Neuralgia.—A very common site of pain is over the symphysis pubis, probably from the strain of parturition. We have already referred to the fact that the symphysis pubis is sometimes injured

during an instrumental delivery, and even in a spontaneous delivery (p. 596). Little wonder, therefore, that a pubic neuralgia of some severity and persistence does occasionally occur.

Another site of pain or neuralgia is the region of the coccyx. Such pain is termed "coccydynia." It results from injury of the sacro-coccygeal joint (p. 592). If the discomfort does not disappear the coccyx should be excised.

Tumours.—Uterine and ovarian tumours which have obstructed labour, but not seriously, may sometimes be injured. This predisposes them to infection and/or necrosis in the puerperium (p. 297). Ovarian cysts are liable to undergo torsion (pp. 297, 1022).

PART VII
THE INFANT IN THE FIRST MONTH

Another important point is that the majority of neonatal deaths are due to the same causes as in still-births. The total of still-births and neonatal deaths forms two-thirds to three-fourths of the aggregate infant deaths from the onset of labour to the end of the first year. These early infant deaths (natal and neonatal), great in their mass, are also intractable to reduction; and this has been the experience of every country where vital statistics are kept.

Causes.—The main pathological processes that are the immediate causes of natal and neonatal deaths fall into the following groups: 'severe congenital defects,' asphyxia, intracranial and other forms of hæmorrhage, infection and miscellaneous conditions. Many series post-mortem examinations in hospital cases of still-births and neonatal deaths have been carried out, and these show a varying distribution of the pathological causes mentioned; and in every series there is a not inconsiderable proportion (about 10 per cent.), where section does not disclose the cause of death. But all these pathological investigations broadly agree in assigning the causes of death in a substantial majority of cases to morbid processes before and during birth. Thus in a recent series at the Maternity Pavilion, Royal Infirmary, Edinburgh, about 75 per cent. of the aggregate of 650 still-births and neonatal deaths were due to congenital defects, asphyxia, intracranial hæmorrhage, and unknown deaths before birth, and the remaining 25 per cent. were due largely to post-natal infections and a small miscellaneous group. *The practical significance of this is that the problems of study and control created by the larger group belong mainly to obstetrics, and those of the smaller group to pædiatrics. But the solution of these problems can best be achieved by a thorough combined effort of study by obstetricians and pædiatricians.*

PREMATURITY.—When the problem of prematurity, embedded in this total problem of still-births and neonatal deaths, is taken out and isolated, it is seen to be one of outstanding importance. In the Edinburgh series of 650 still-births and neonatal deaths already referred to, 349 were premature (on a weight standard of $5\frac{1}{2}$ lbs. for prematurity). Prematurity thus contributed more than half of the total deaths. The total number of prematures dead and surviving was 653, giving a death-rate of over 50 per cent. for prematures. The incidence of prematurity in this hospital series of viable births was 12 per cent.; and although accurate figures for the incidence of prematurity in the whole population is unknown, it may be put at about 10 per cent. This small percentage of prematures probably accounts for at least half of the total deaths during birth and in the first month after birth. It is therefore clear that any serious effort to reduce infant deaths in the first month must include a special and separate study of prematurity resulting in a control of its causes and a better management of the premature baby after birth.

INFECTION.—Although the incidence of fatal infections in the new-

born has been reduced, the risk of infection must always remain in maternity hospitals where numbers of newborn infants, *highly vulnerable to infection*, are congregated. Epidemic gastro-enteritis is the principal fatal infection; but respiratory infection ending in pneumonia and thrush must also be kept constantly in mind. These infections, and infection from the umbilicus, can only be countered by strict nursing technique, conscientiously and thoroughly maintained.

STUDY AND CONTROL OF NATAL AND NEONATAL MORTALITY.—The continuing heavy loss of infant life during birth and the first month of life constitutes a great problem of preventive medicine. This problem is a double one, obstetric and pædiatric. On the obstetric side the broad strategy of attack lies: (a) in improvement of the nutrition and diet of the mother during pregnancy; (b) in the skilful management of labour. On the pædiatric side the main lines of attack are the prevention of infection from the moment of birth and the early establishment of good nutrition by successful dietetics. If a better control of this double problem is to be achieved the following main requirements must be met: A strengthening of the pædiatric staffs in maternity hospitals; further pathological studies of the exact causes of infant deaths; carefully planned and combined investigations by obstetricians, pædiatricians and pathologists of the main problems, and particularly prematurity and infection; better instruction of doctors, midwives and health visitors in infant dietetics and infant hygiene during the first month.

NUTRITION OF THE NEWBORN

The puerperium, so important for the mother in determining her recovery from the stress and danger of labour, is also a critical period for the newborn infant exposed likewise to danger in labour, and now commencing a new phase of life. Considered from the point of view of the infant, this period is called the *neonatal period*; it lasts for about a month, and runs parallel with and almost extends to the length of the puerperium. This first month of the infant's life is important, and is a special period of its life with peculiar physiological conditions and peculiar pathological problems. There are the injuries and complications of birth, the problem of feeding and digestion, and a group of disorders and diseases not dependent upon food and digestion. The subject of natal injuries has already been dealt with (p. 608 *et seq.*). In this chapter we shall deal mainly with the nutrition of the baby, with some reference also to other non-nutritional disturbances, during the first month of life. The discussion will thus include breast feeding, its physiology, management and difficulties; artificial feeding; and a group of non-digestive disorders.

Careful and skilled supervision of the infant is of great importance in the neonatal period—especially in establishing the new process of

digestion and in correcting its minor defects. In this critical first month there are three epochs of special importance: the first day, which determines whether the baby is healthy, and has escaped uninjured from the stress of labour; the end of the first week, which decides the successful initiation of breast feeding; and the end of the month, which ought to see good digestion established.

BREAST FEEDING

The superiority of breast milk over any other form of infant food is a fact that everyone agrees to: it is shown by the better physique of breast-fed babies and by their far greater immunity from the infections and diseases of infancy. Breast feeding is also of real advantage to the mother in aiding the processes of involution. But along with this belief in the importance and the advantages of breast feeding, there are other opinions or prejudices regarding it which are widely prevalent among mothers and maternity nurses, and in the medical profession. These are of two kinds: firstly, that many mothers are unable to nurse their babies, or can do so only for a few weeks, a view that is apparently supported by the delayed flow of milk in the beginning of lactation, or by its occasional rapid disappearance after a few weeks: secondly, that many of the symptoms of indigestion and malnutrition in breast-fed infants are due to some unsuitable and noxious quality of the maternal milk. So that, although everyone is convinced in theory of the importance and value of breast feeding, yet in actual practice many difficulties can and do occur, and this ideal method of feeding is readily given up. These widely current opinions regarding the practical difficulties are too often false, and are due to ignorance of the *physiology* of the secretion of milk in the breast of the mother and of its digestion by the baby, of the practical *management* of breast feeding, and of the methods of dealing with the *difficulties* that may occur often enough in the course of breast feeding. We shall therefore deal now with the physiology, the management and the difficulties of breast feeding in the first month of life.

PHYSIOLOGY OF BREAST FEEDING.—Breast feeding is a threefold process, and includes lactation, suckling and digestion. We have therefore to consider (1) the composition of the milk; (2) its secretion, storage and removal from the breasts, and the conditions that favour a full supply of good milk; and (3) its digestion in the stomach and bowels.

Human milk contains protein, fat, carbohydrates, salts and vitamins in proportions and of a kind that are perfectly adapted to the digestion and nutrition of the infant. The milk of the first few days is scanty and concentrated, and is known as *colostrum*. The special characters of colostrum milk disappear with the establishment of a free flow at the end of the first week, although colostrum corpuscles

can be detected until the end of the first month. After the colostrum period, the composition of the milk remains almost uniform throughout lactation. The quantity of milk secreted rises rapidly during the first two months, and after this more slowly until the end of lactation at about the ninth or tenth month. Human milk is practically sterile from organisms.

Lactation Suckling and Digestion.—The breast consists of three parts: (1) the parenchyma or gland proper, made up of fifteen to twenty lobules of acinous tissue; (2) a system of ducts leading from the secreting lobules and converging beneath the nipple—these ducts with their ampulliform dilatations forming a reservoir for the storage of milk; and (3) the nipple, by which the milk is drawn into the mouth of the baby.

Early in pregnancy the breasts become engorged, and there is a stage of preparation for *lactation*. Not until labour is completed does active secretion of milk occur—this release of secretion being probably due to the escape into the maternal blood of some endocrine hormone (p. 155).

Once active lactation is established, the conditions in the mother that favour an abundant supply of good milk are satisfactory general health, physical rest and mental calm, and a simple nourishing diet with additional fluid. But there is another factor, more important than any of these in maintaining a continual free flow of milk, and that is the regular and complete emptying of the breasts, or, to be more precise, the reservoir of the ducts, by the *suckling* of the baby. *And this is a factor which is under our control, and by attention to which we can in many cases maintain a good supply of milk, or restore it where it is failing.* The most powerful stimulus to milk secretion is the regular and complete emptying of the breasts by suckling.

As to *digestion* in the baby, it is important to remember that this is a new and untried process; and also that the process is a twofold one, chemical and mechanical. We shall see that some of the early digestive troubles in breast-fed infants are probably due to mechanical faults in digestion, to disturbances of peristaltic and sphincter action. The *appetite* of the baby should be observed; healthy appetite is shown by the baby's eagerness to take the breast at the beginning of each feed. Putting-up or possetting of milk is common enough, and is compatible with good digestion; but copious or forcible vomiting is a morbid condition. After the dark-green meconium stools of the first few days the *fæces* develop the bright yellow colour and the homogeneous jelly-like consistence of the healthy breast-milk stool—the appearance of the stool is of great value in judging of the healthy digestion of the baby.

Supervision and Management of Breast Feeding.—For three or four days after birth there is a pause. This is the true colostrum period. It is a time of *rest* both for mother and child after the stress

of labour, and also a time of preparation for the new feeding processes, again both for mother and infant. The suction of the scanty colostrum from the breasts stimulates their more active secretion, and the ingestion of this by the baby gives a preliminary trial to the new digestive apparatus. During these resting days there is loss of weight— $\frac{1}{2}$ to $\frac{3}{4}$ lb. This loss of weight by the baby and this delay in the free flow of milk from the breasts are physiological conditions, and yet they are often a cause of anxiety to the mother.

After three or four days, or in nearly all cases by the end of the first week, there is a sudden increase of secretory activity and an abundant flow of milk into the breasts which enlarge and become distended. And the intake of this larger food supply into the stomach of the baby sets its digestive machine going at full speed. This full-speed trial of digestion at the end of the first week is important, because it is at this time that a group of minor digestive disorders are apt to appear.

These two phases of digestion in the first week are therefore significant—the days of preparation or rehearsal, and the first days of the real inauguration.

MANAGEMENT.—The *rules and technique of breast feeding* are as follows :—

Feeding Intervals.—During the colostrum period of the first three or four days the baby should be put to the breast twice in the first day ; and four or five times daily during the next two or three days until the free flow of milk appears. During this early period it is important that the nurse should satisfy herself that the baby is passing urine freely and shows no sign of thirst ; during this early period she should also offer the baby some extra fluid in the form of plain or slightly sweetened water. Deprivation of fluid at this time may cause disturbance in two ways : by a general fever, known as inanition fever, and by irritation of the pelvis of the kidneys by concentrated urine. The symptoms and the treatment of these two types of disturbance will be described later. The condition of the mother's breasts and nipples should also be carefully observed.

With the appearance of the free flow of milk, the interval of feeding should be three hours, and after a month this may be increased to four hours. In either case one or two feeds should be omitted during the night, thus making seven, six or five feeds in the twenty-four hours. At the outset regularity and punctuality in the intervals prescribed are important : once good lactation and digestion are established, a little latitude may be allowed.

Duration of Suckling.—If the baby is hungry and vigorous, the greater part of the milk within the breast is drawn off in the first five minutes, and by far the greatest part in ten minutes. But it is important that the breast or breasts should be thoroughly emptied, both to promote good secretion and to secure the last milk which is

richer in fat : this will be ensured by an average period of suckling of fifteen minutes. It is not good practice to exceed this, because of the sucking and swallowing of air that may take place.

Should *one or both breasts* be used at each nursing ? In ordinary cases with sufficient milk the use of one breast is preferable. But when the milk is scanty, it is better to use both breasts at each nursing, beginning alternately with the right and then with the left. The guiding rule in either case is to secure the thorough emptying of the milk reservoir contained in the mammary ducts.

The *attitude or position* of the baby at the breast should be one of comfort, and the suction of milk is assisted by the mother grasping the breast with finger and thumb immediately behind the nipple, and alternately increasing and relaxing the pressure. Also the baby must not be allowed to fall asleep at the breast. These may seem small points of nursing technique, but attention to them may determine the success of breast feeding.

Hygiene of the breasts includes the care of the nipples at the end of pregnancy, when they should be carefully drawn out and toughened as described (p. 189). Retraction of the nipples may be a most troublesome difficulty in the beginning of lactation. During lactation itself the nipples and breasts should be sponged with water after each nursing, carefully dried and covered with clean linen or gauze.

Rules of *diet and régime* for the nursing mother are few ; abundant nourishing and simple food, with some extra fluid ; some attention to the matters of exercise and rest ; and a life free from excitement or anxiety. The mother is likely to believe that breast-milk is the best food for her baby, *but she may require encouragement to believe that she is able to provide an adequate supply*. Encouragement is, therefore, a part of the general régime in creating confidence and removing anxiety.

The relation of maternal diet in pregnancy to lactation has not been scientifically investigated in woman as it has been in animals, but there can be little doubt that it is important. After birth, a nourishing well-balanced diet must favour lactation ; but the smaller details of diet still bulk too largely in the minds of mothers and nurses. There is no evidence that any single food or drug increases milk secretion, although pituitrin has a definite temporary effect in doing so. Certain drugs may be excreted in the maternal milk and then exert their action on the baby, and it is generally believed that elements in the maternal diet may also have an effect upon the baby in this way.

Clinical observation of the breast-fed baby is of the first importance. Its health and its healthy growth may be verified by observation of certain signs and symptoms which form the clinical standards of health in infancy. These standards should be looked for by the doctor and the nurse ; their observation is a most valuable guide and test of the success of breast feeding ; their appreciation is also of value

in recognising the signs of ill-health ; and they are often neglected, while too much importance is attached to the behaviour of the weight-curve. The need for observation of these clinical standards of health is equally applicable to bottle-fed babies.

Good digestion generally means good health, and the following points should be looked for as evidence of good digestion. The tongue of the baby should be clean, moist and not too red ; it is a good sign when the lips are wet with saliva. *Good appetite* is shown by the eagerness and impatience of the baby when the time of feeding has come and by its steady concentration on suckling. *Vomiting* is very common in the neonatal period. The effortless regurgitation of a little milk from a full stomach is physiological, and is usually accompanied by an eructation of air which has been swallowed during suckling. But vomiting which is copious, forcible and frequent does not occur in health.

The *stool* of the infant in health has a definite appearance, being of a bright yellow colour (orange or ochre), homogeneous, and of the consistence of loose jelly. It has a heavy though not unpleasant odour, and is faintly acid in reaction. A stool of this character is a sure sign of good digestion. When the first free flow of milk takes place, the meconium stool of the first few days of life is replaced by the kind of stool just described : at this time the stools may be green for a few days, but the persistence of green stools is never normal.

The *weight* of the body is accurately measured by a weighing-machine. The weighing-machine is of great value, but even without it a fairly accurate indication of the weight may be obtained by observation of the superficial fat and of the length of the body. The nurse or mother, handling the child every day and closely examining its body in every part, becomes very skilful in noticing even a slight increase or decrease of the fatty layer.

The *skin* of the baby in health has qualities that are expressed by the word bloom. It is soft, smooth and supple. Its colour varies, being in some white, and in others pink like a light rose petal ; but in health this colour is always clear and pure. Another sign of a healthy skin is the mottled colour of the limbs. Immediately after birth the skin may be in a rather dirty and greasy condition because of the vernix caseosa, but this should clear in a few days. Physiological icterus may also mar the colour and condition of the skin. The *eye* is another surface the condition of which is an index of health, the moisture on the conjunctiva in health giving it a shining lustre. The same is true of the tongue. These surfaces of the skin and eye, especially after the first week, are almost unerring witnesses of good health. The fine bloom of the skin is a more delicate indicator of the acme of health than is the weight or fatness ; this is well shown in the dull pasty whiteness of some big and fat babies.

Muscular movement is another mark of health and strength. Some

activity of movement is present from birth, but as the weeks pass it increases in vigour. The loudness of the baby's cry is another manifestation of muscular power. Strength or vigour is one of the great outward signs of bodily health through life.

The state of the *mind and emotions* in the first weeks after birth is of less clinical value than it becomes in later infancy. The newborn baby should spend the greater part of the day and night in sleep. When awake it should be placid and contented, or show signs of happiness, with occasional moments of grief and tears. A baby that cries much is either suffering from pain or hunger or indigestion, or from some general disease.

The careful clinical observation of these different features of life in the newborn infant—its digestion, its nutrition, its skin, its muscular vigour and its moods—provides a most reliable test of the health and healthy progress of the breast-fed baby. If the information from all these directions is satisfactory, we may be quite sure that the food of the baby is right both in its quality and quantity, and that its digestion is good.

Difficulties in Breast Feeding.—A great many things may happen to make breast feeding difficult. Some of these difficulties are insuperable, but many of them can be readily overcome. They may arise from the side of the mother or from the child. They may depend upon some local disturbance in the breast, that is, of the process of lactation; or upon some general and constitutional condition in the mother. If they arise in the child, the difficulty again may be in the local process concerned with nutrition, that is, in the digestive tract; or it may depend upon some general and constitutional condition of the child. Of the many difficulties that do arise, the two that are most common, and that are often made the occasion of weaning, are an insufficient supply of breast-milk and various types of digestive upset in the baby. These two kinds of difficulty will be described in greater detail, while the account of the others will be more brief. Breast feeding should not be continued if it is injurious either to the mother or to the child, and that condition is the only true justification of weaning. *But weaning in the neonatal period is too often carried out without sufficient reason, and from ignorance of the true nature of the difficulties that arise and of the remedial treatment that can overcome them.*

THE MATERNAL DIFFICULTIES are of two kinds: local conditions in the breast and general disturbances.

Of the *local conditions*, the commonest and the most troublesome is an *insufficient secretion of milk*. This may happen in several ways. There may be delay in the appearance of the free flow of milk that should take place about the fourth day. This *delayed lactation* nearly always occurs after Cæsarean section, also after prolonged and exhausting labour, and after premature labour. There may also be

failure of milk secretion after it has been established—this often happens in nursing mothers of the working class when they get up and resume their household duties—or it may happen more gradually at a later period in lactation. The treatment of these two types is similar. The first thing to do is to provide additional food for the baby, either human milk, if it can be obtained, or modified and diluted milk, or some patent milk food. This food is *supplementary* to the scanty supply of milk that the breast is giving. In the case of delayed lactation this supplementary feeding should not be begun until after the fourth day, when an ounce of diluted and boiled cow's milk (equal parts of milk and water with a little sugar) may be given after each breast feed. The next part of the treatment is to try to increase milk secretion in the breasts: (a) by attention to the rules for the management and technique of suckling already given (p. 672); (b) by manual expression of the remaining milk from the breasts *after suckling by the baby*, combined with the use of the breast-pump. This is a valuable part of the treatment as it brings into play the powerful stimulus of empty breasts, and in a few days it often increases to a noticeable degree the amount of milk; (c) by attention to the general health, régime and diet of the mother. Many of these cases of delay in the commencement of lactation, and of failure after it has begun, can be put right by these measures.

Morbid Conditions of the Breast.—*Painful engorgement of the breasts* may occur with the sudden increased secretion of milk in the middle of the first week or even earlier. The whole breasts become swollen, tense and painful and feel knotted owing to swelling of the individual gland lobules. The treatment is simple and effective: hot fomentations or magnesium sulphate soaks, gentle massage with warm olive oil, reduction of fluids and a saline aperient, and if necessary the stopping of suckling for a day or two. *Tender or fissured nipples* are treated by lotions and ointments, and by the use of a nipple shield. *Interstitial mastitis and abscess* is a more serious difficulty, but it is not one that need call for weaning. The inflammation is external to the breast lobules and ducts, and usually goes on to abscess formation, and requires incision (*vide* p. 657). Suckling from the affected breast is stopped for two or three weeks, but when healing is complete it may be resumed and breast secretion restored. *Retracted nipples* may prove an insuperable obstacle to suckling. Treatment consists in softening of the hard and sunk nipples, and pulling them out and stretching. This process may be assisted by the use of a breast-pump or of an ordinary suction cupping-glass.

General Disturbance and Disease.—A great many kinds of general disease and constitutional disturbance in the mother may occur during the puerperium, and many of these call for weaning which may be temporary or permanent. But in only one of these is the contra-indication to nursing absolute. *Tuberculosis* in the mother, whether

latent or active, pulmonary or extrapulmonary, is an absolute bar to nursing, and on the double ground of danger both to mother and child. And as regards the child, this means more than the cessation of suckling; it also requires *the physical separation of the baby from the mother*. The serious complications of labour, *hæmorrhage*, *sepsis* and *eclampsia*, may now be considered; all of them may make breast feeding impossible, but they need not always do so, and each case should receive separate consideration. In *severe hæmorrhage* from the uterus it may be a real advantage to the mother to put the baby to the breast soon after labour, for the suckling of the breast may have a definite and appreciable effect in promoting the contraction of the flabby uterus. *Puerperal septicæmia* will in most cases make breast feeding impossible. *Eclampsia*, on the other hand, cannot be made the subject of a general rule. If the convulsions cease with the termination of labour, and the mother's general condition is improved, it may be advantageous to the mother to permit the normal free secretion of milk, as this may encourage the other processes of excretion and elimination; and there is no evidence that where this is done the baby is injured. *Heart disease* with failure of compensation will seldom permit breast feeding. *Pyelitis with pyuria*, and especially when it persists and is accompanied by fever, commonly causes difficulty and makes weaning necessary. In *general debility and anæmia* a fair trial should be given to breast feeding, but it should not be carried on if the mother's condition does not improve or if it becomes worse. *Acute illness* in the puerperium, such as pneumonia, influenza, etc., will nearly always stop breast feeding. But it should be remembered that breast secretion may be restored after the lapse of a fortnight or more, if the baby is again put to the breast. The conditions of *menstruation* and *pregnancy* do not arise in the puerperium, and their effect upon breast feeding need not be considered here.

DIFFICULTIES IN THE BABY.—As in the case of the mother, so also in the child there are many different kinds of disturbance which can make breast feeding difficult. Here also these fall naturally into two groups—those where the disorder is in the digestive tract, and those where it is of a general nature.

Digestive disorder in breast-fed infants may be of many kinds, and it will not be possible to deal with them all. There are, however, certain types which are very common, which occur early in the neonatal period, which are nearly all of a functional and minor nature, which are often and wrongly attributed to some fault in the breast milk, and which on that account are often made the occasion of weaning. These particular types of minor digestive disorder are as follows: (1) a special type of vomiting; (2) mild diarrhœa, with green and frequent stools; (3) failure to gain weight after the initial loss; (4) a special type of constipation.

These four groups of *minor digestive disorder* form the majority of,

although not all, the cases of dyspepsia in young breast-fed babies. At the outset all are trivial in their effect upon health and digestion, and they may easily escape notice for some time. The great majority of the cases occur about the end of the first week of life, and the first, second and fourth groups are not due either to a fault in the milk or to a failure of chemical digestion, but to some disturbance in the muscular apparatus of digestion in the stomach or intestine—a maladjustment between peristaltic action and sphincter control.

The *special type of vomiting* has to be distinguished from other forms of vomiting in young babies. It begins early, very often about the end of the first week, when the free flow of breast milk is being established. *It is commoner in girls than in boys, thus differing from pyloric stenosis.* The vomiting is frequent, copious and forcible, occurring immediately or soon after nursing. At first, and for some time, there are no other symptoms of dyspepsia: the baby is lively and healthy-looking; the tongue is clean; the stools have the normal yellow appearance, although later they become dry and constipated; and for a time there may be a gain in weight. It will be found also that these babies are generally impatient and irritable; they take the breast with greedy haste, and also show restless and wriggling movements of the body. The excellent general state of the baby and its gain in weight suggest that the cause of this vomiting is a simple disturbance of the muscular function of the stomach—a condition of gastric spasm, or an inco-ordination between gastric peristalsis and the pyloric sphincter, this occurring at a time when the muscular functions of the stomach are first brought into full play. Another factor is an excess of milk swallowed along with air. Once begun, the vomiting is apt to persist and become habitual.

The condition is too obvious to be overlooked, and there should be no difficulty in distinguishing it from a number of other disorders that produce frequent and forcible vomiting at this early period of life—from true gastric catarrh, from atresia and stenosis of various parts of the bowel, from pyloric stenosis which may rarely produce symptoms a few days after birth, and from general acute diseases. But in all these other conditions there are other and different clinical features, and there is, from the outset or very soon, a state of serious illness.

The treatment is as follows: To control the general nervous irritability the baby should be gently handled and put quietly to the breast, and induced to suck slowly, with intervals to allow eructation of air. The period of suckling should be reduced, and on its completion the baby should be held upright and soothed to sleep in the mother's arms. More frequent suckling for a few days is helpful. If these measures produce no improvement, give, ten minutes before each feed, $\frac{1}{2}$ ounce of warm water in a bottle, adding 1 or 2 grains of sodium citrate. Chloral hydrate, $\frac{1}{2}$ grain thrice daily, may also be given for a few days.

Mild diarrhœa with green stools is a common occurrence in healthy breast-fed babies in the second half of the first week of life. At this time, when the normal three or four yellow stools usually replace the earlier meconium stools, there may be green stools to the number of five or six—a condition of mild diarrhœa. This condition is more apt to occur where there is a sudden engorgement of the breasts and an unusually copious flow of milk; and it is probably the result of overfeeding and of increased peristaltic action of the large bowel. There are no symptoms of real indigestion; the stools themselves are well digested, uniform in consistence, and show neither mucus nor gaseous fermentation; there is no vomiting. The baby is hungry, sleeps well and increases in weight. This condition of green diarrhœa is thus compatible with good health and good digestion, but it is one of unstable equilibrium. If it continues, abnormal symptoms appear. The stools become frothy, they are no longer uniform, and show small masses of fatty substance and mucus, while the buttocks become red and sore from the contact of the irritating stools. The baby is now fretful, although still hungry; it may continue to gain weight, or may lose a little. Vomiting and colic may now be added to the other symptoms, when the condition passes into one of true dyspepsia. On the other hand, the early stage of green stools may give place in a few days to the yellow stools of perfect health.

Treatment.—As the condition may right itself, no treatment is required for a day or two. But if it persists for a few days, or becomes worse, a small dose of castor oil (half a teaspoonful) and a reduction in the number and duration of the suckling periods will often put the matter right. If, however, the stools remain frequent and green, small doses of a plain petroleum emulsion—a half-teaspoonful, diluted with water, twice or thrice daily, should be given (this emulsion should not contain any laxative, such as phenolphthalein or magnesia): this should be continued for a week after the stools have become yellow, and resumed if there should be a relapse. Paraffin emulsion in these small doses is an intestinal sedative, and protects the bowel from the irritation of its contents; it is a most effective remedy in this common neonatal condition. It is important to begin treatment at an early stage, for it is easy to overlook the condition at first, and the downward drift may be very slow: but when a state of serious dyspepsia has been reached, successful treatment is more difficult. Many of the cases of dyspeptic marasmus, admitted to the wards of children's hospitals, begin in this way as cases of this mild "digestive" disorder in the first week of life; they are overlooked and untreated in the early stage, then they are weaned, and go from bad to worse.

Failure to gain Weight after the Initial Loss.—This happens often, and is caused by a number of different pathological conditions, some of which are located in the digestive tract, and many of which are outside it. After the initial loss of weight in the first few days, the

weight remains stationary or only rises slowly. The baby is not ill, but is not lively nor hungry. There may be a little vomiting, and the stools may be abnormal; but these dyspeptic symptoms are variable, and may be absent. The causes of this may be manifold: there may be a variety of mild digestive disturbances in the baby; or general debility, and especially prematurity; or chronic latent disease in the baby, such as congenital syphilis; or serious congenital defect, such as cardiac defect or mental defect; or the cause may be an insufficiency of breast milk in the mother, or faults in the management of suckling. These general conditions will be discussed later: insufficiency of breast milk has already been dealt with. The dyspeptic conditions in the baby are thrush, mild stomatitis, and a torpid and mild dyspepsia with or without icterus neonatorum. The appropriate treatment is attention to the mouth; a small single dose of castor oil or a few doses of fluid magnesia. The prescription of tinct. rhei. co. ℥i, sod. bicarb. gr. i, glycerine ℥ii, aq. ad 3i, given thrice daily before the feeds, and continued for a few days, is often efficacious; or grey powder gr. $\frac{1}{4}$ may be given for a few days. The condition is trivial and easily remedied, but it deserves attention.

A Special Type of Constipation.—This may occur in the first fortnight of life, but it does so oftener towards the end of the first month. It usually begins suddenly and after a period of loose green motions, but sometimes without any apparent cause. Although the bowels are only opened once daily, or once in two days, the stool itself is not constipated but soft and yellow. Besides the constipation there is at first no other symptom; the digestion and general health of the baby are excellent. But if constipation continues, vomiting and other dyspeptic conditions nearly always add themselves. The cause of the constipation is anal spasm, and this is shown by the small puckered anal orifice, and by the strong clenching grip on the finger inserted into the anal canal. Whenever sudden definite constipation without other serious symptoms is reported in breast-fed babies, the previous state of the stools should be inquired into, and the anus inspected.

Anal fissure, which is always associated with severe anal spasm, is a different and more severe condition, also producing obstinate constipation, but, in addition, pain during passage of the stool and tenesmus, with stretching out of the legs after defæcation. In simple anal spasm, although shallow dry excoriations may be seen along the anal margin, these more severe symptoms are absent.

Treatment.—The use of aperients or suppositories in this condition is either futile or merely palliative. The condition is a local one—a spasmodic closure of the anus—and can only be effectively dealt with by local treatment. Instructions are given to the mother or nurse to dilate the anal canal once or twice daily by insertion of the little finger, and boldly to stretch it open in every direction: the finger is thickly covered with some healing and soothing ointment, such as 2 to 5 per

cent. ichthyol in equal parts of lanoline and vaseline. After a time pure lanoline will be sufficient. This daily dilatation should be continued for at least a week after the apparent cure, and resumed on any threatened return of constipation. This simple local treatment is rapidly successful, and in a few days spontaneous evacuation of the bowels will begin to take place.

In some cases this type of constipation appears to be due to local spasm in the rectum or pelvic colon. In these the passage of an oiled catheter into the rectum is sufficient to bring away a soft, well-digested stool, and the use of this local stimulus for a few days is followed by the regular and spontaneous opening of the bowels.

GENERAL CONDITIONS IN THE INFANT.—*Prematurity* deserves first mention. Here the prospects of survival will depend upon the age of the baby, upon its weight, and upon the presence or absence of disease apart from prematurity. A weight of 2 lbs. marks the limit at which survival is usually possible; and in any case under 3 lbs. the prospects are poor. Between 3 and 5 lbs. they are much better, and over 5 lbs. they are fairly good—always providing that the general constitution is fairly sound.

Treatment.—The protection of the premature baby from cold is very important. This involves the provision of special clothing, the trunk, limbs and head being encased in a thick, wadded garment, and the use of an incubator, or a special lined cot, and of hot-water bottles. No bathing is allowed until the infant is gaining strength and weight. The strictest precautions against alimentary and respiratory infection must be taken.

Breast feeding is here specially necessary. The infant may be too feeble to suckle the breast, when the milk must be drawn off and given by bottle, or it may even have to be pipetted into the mouth, so that the method of feeding may proceed in stages, from a pipette to a bottle containing breast milk, and lastly to suckling the breast. In the smallest and feeblest prematures tube-feeding may be necessary for a week or longer. If the process of lactation is delayed, and foster breast milk cannot be got, small feeds should be given of cow's milk (skimmed) and water in equal parts, with the addition of 5 per cent. dextrimaltose

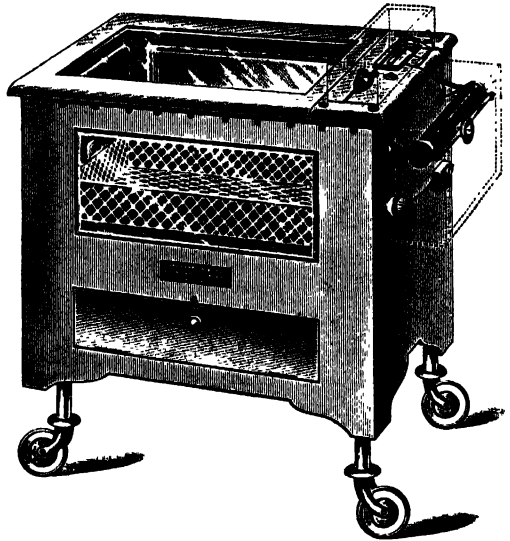


FIG. 264.—Incubator.

and 1 grain of sodium citrate per ounce of milk. A few drops of brandy should also be given several times a day. For a day or two only 1 dram of this supplementary feed may be taken every two hours, with additional feeds of sweetened water, increasing gradually to 2 drams, and beyond that as indicated by the appetite. In these cases it is not possible to give exact directions as to quantity, this being determined by the appetite, the state of the digestion and the general condition of the child. The feeds should be given every two hours.

If there is digestive disorder as well, this must be treated by the methods and rules already detailed in the description of digestive disorders in breast-fed infants. When good digestion is established, the use of cod-liver oil, in doses of a few drops of the pure or emulsified oil, is of great value.

Even where breast milk fails or is not available, it is remarkable how very small and feeble premature infants will survive and thrive on carefully prepared and gradually increased feeds of cow's milk.

The other general conditions in the baby that cause malnutrition and digestive disturbance may now be mentioned and briefly discussed. There may be general latent infective disease, of which *congenital syphilis* is a good example; where this occurs and there are no florid signs of syphilis, a careful examination will usually show some suggestive appearances—a slight nasal discharge, a dermatitis round the mouth and eyes and round the perineum, a raw red condition of the palms and soles. Here the treatment is the specific medication of the disease and perseverance in breast feeding. There are also conditions of general congenital defect, such as *cardiac defect* and *mental defect*, which again will only be detected by careful clinical examination; in these again the important part of treatment is to maintain breast feeding, and to correct any digestive disorder by the methods already described.

In conclusion, in all these types of difficulty in breast feeding arising on the part of the baby, the problem of nutrition will not be simplified but rather made more difficult by weaning, and *the right course is to persevere in breast feeding, using appropriate measures to increase the supply of breast milk, and to correct digestive disorder in the baby*. Indeed, there is only one condition in the baby which calls for weaning, and that is the very rare condition of idiosyncrasy of the baby to its mother's milk.

ARTIFICIAL FEEDING IN THE FIRST MONTH

If breast milk is not available for the newly born infant, the next best food is cow's milk. Cow's milk can be used as fresh modified milk, as milk powder or as condensed milk. These manufactured milks are prepared in many ways, and with great skill and care; they are preserved from contamination in tins, and their reconstitution into

fluid milk is an easy and simple process that can be carried out by the most ignorant mother. In spite of these advantages the weight of medical opinion is still in favour of the use of suitably modified fresh cow's milk. We shall now describe in detail the use of fresh cow's milk as a substitute food for the newly born infant for whom human milk cannot be obtained.

In the first place, a comparison of these two kinds of mammalian milks must be made. In their caloric value the two milks are nearly equal; they have also a general resemblance in their chemical constitution. But they differ in important ways; their chemical constituents differ a good deal in their quantitative distribution, and while human milk is practically always sterile, cow's milk, even when produced and marketed under the most perfect conditions, is never free from organisms, and in ordinary conditions is swarming with them.

The chemical constitution of the two milks is shown in the following table :—

	Human Milk.	Cow's Milk.
	Per Cent.	Per Cent.
Protein	1·25	3·50
Casein	0·4	2·8
Lactalbumin	0·8	0·7
Fat	3·5	3·5
Carbohydrate (lactose)	7·5	4·5
Salts	0·2	0·7
Water	87·5	87·5

The chemical differences between the two milks may be summarised as follows: in cow's milk the protein content is much greater and the sugar is considerably less than in human milk. The difference in protein, and especially in the casein, is the important thing, resulting in the formation of a tough and large mass of curd in the stomach when fresh cow's milk is taken. And the modification of cow's milk as an infant food must achieve two things—the reduction or finer division of the casein curd and the sterilisation of its bacterial content; and while doing this, it must also maintain the nutritive value of this modified milk and restore its vitamin standard to that of human milk. These are the principles that must govern the use of fresh cow's milk as a food for the infant.

The common medical practice at the present time, not only in this country but throughout the world, is to use *diluted* and boiled cow's milk *at the commencement* of the artificial feeding of infants. The object of dilution is to reduce the casein in the milk; but the result is to bring the fat and the sugar in the diluted milk far below their level in human milk. The dilution of cow's milk with an equal volume of water results in the following chemical composition: protein, 1·75 per cent.; fat, 1·75 per cent.; and sugar, 2·25 per cent.

Dilution, therefore, calls for further modification—the addition of some kind of sugar, and possibly also of cream. The following method of using diluted cow's milk for infants in the neonatal period is recommended, the modifications are few and simple, and its results in practice are successful. The principles of this method are to use from the first an *equal* dilution of milk and water, to add to that diluted milk 5 per cent. of sugar and some sodium citrate, but not to add any additional cream. This diluted modified and boiled milk mixture is used from birth; even in the first week greater dilutions are not required nor desirable. The feeding intervals are the same as those recommended for breast feeding—every three hours, with the omission of one or two feeds in the twenty-four hours, making seven or six feeds in the day. If the baby is feeble, or suffering from any digestive disorder, the milk should at first be skimmed, and the return to full milk made when good digestion is established. The following prescription gives such a milk mixture :—

Milk (skimmed, if necessary)	10 ounces
Water	10 „
Sugar (lactose or dextrimaltose)	1 ounce
Sodium citrate	10 grains

The sugar and sodium citrate (conveniently in tabloid form) should first be dissolved in the water and this added to the milk. The mixture is then brought to and kept at boiling-point for a few seconds, cooled quickly, and kept in a clean, covered jug. Scrupulous care must also be taken in sterilising the feeding-bottles and teats.

There remains the vexed question of the amount of milk mixture to be given at each feed. In the early weeks of life this cannot be a matter of rule; it must be determined by several considerations—the appetite of the baby, the state of the digestion, and especially the appearance of the stool, the general clinical observation, and the weight of the baby. In an average healthy baby the amount per feed of such a mixture at the end of the first week should be 2 or 3 ounces, and at the end of the first month about 3 or 4 ounces.

It is important to avoid *the common error of underfeeding*. This is more likely to happen with the more diluted mixtures which are often used in these early weeks, but it may easily happen also with more concentrated milk mixtures. To avoid this, it should be an invariable rule to reckon up *the total amount of milk (not diluted milk) being given in twenty-four hours*, remembering also that the practical test as to whether a baby is getting enough milk is not a formula derived from its age and weight, but *the ascertainment of its actual condition* as to nutrition vigour colour and digestion.

When the baby gives evidence of good digestion of the new food, it is often desirable during the first month to concentrate the milk in the mixture and reduce the water, so that at the end of the month the milk may form two or even three parts of the total mixture. At

the same time the amount of sugar will be proportionately reduced, and the amount of citrate of soda may also be diminished.

Some additional minor points may be made. The kind of sugar used is not important; dextrimaltose is perhaps the best for general use, and especially if there is some digestive disorder; cane sugar has the objection of sweetening too much the taste of the milk, but it has the advantage to a poor household of its cheapness. It is not necessary nor advantageous to use orange juice in the first month, but a little cod-liver oil, either as pure oil, emulsion, or combined with malt, is often valuable, for it provides both a stimulus to general metabolism, and also a little additional fat in the food. The addition of water between the feeds is optional; it is, of course, necessary if the baby shows thirst or if the urine is scanty.

If digestive disorder should develop, it can usually be overcome by the same methods laid down for digestive disorder in breast-fed babies; and in their early stages these digestive disorders are usually trivial and easily remedied. The golden rule in digestive disorders in the first month of life, whether in breast or bottle fed babies, is *obsta principiis*, to note and treat the earliest symptoms. The common mistake in both types of case is to change the feeding and to resort to very weak dilutions of milk, thus adding insufficiency of food to the original digestive disorder.

The whole problem of artificial feeding in the first month may be summarised as follows: As compared with breast feeding, the procedure is complicated and more liable to go wrong; its results as regards health and healthy growth are not so good. But if its principles are understood, if the details of its application are carefully carried out, and if its difficulties are met in the early stages by the proper readjustments, good digestion can be established in the great majority of artificially fed infants in the first month of life. Artificial feeding and the restoration of good digestion in older infants suffering from chronic indigestion and malnutrition is another and a far more difficult problem; but it is not one that we are concerned with here, except to emphasise that these very difficult chronic cases nearly always have their origin in the critical early phase of digestion in the neonatal period, and that the more serious condition could nearly always have been prevented by attention and simple treatment at its early stage in the first weeks of life.

OTHER DISEASES AND DISORDERS OF THE NEWLY BORN

We have now dealt with the problems of food and digestion in the newly born infant and the management of digestive disorders; in a preceding chapter (Chapter XXXV) an account has also been given of the injuries and complications that may result from birth. There remain a varied group of disorders that may arise in the neonatal

period, and that are not dependent upon food and digestion. Among this very miscellaneous group there are the acute and chronic infections—septicæmia, meningitis, pneumonia, syphilis; the great range of developmental defects; a variety of skin diseases, and certain blood diseases, etc. Most of these conditions show definite and easily recognised features, so that the problem of diagnosis is easy enough, although in many, treatment is often unsuccessful. It will be sufficient to give in this section a short account of some of those that are peculiar to this period of life and that are amenable to treatment.

Renal Conditions.—In the first place, a small group will be described where the disturbance depends upon some disorder of renal function; in two of these the clinical features give little indication of the focus of disturbance. *Dehydration* or *inanition fever* is a condition of high fever, occurring in the first few days of life before the free flow of breast milk appears. The name is a misnomer, for the condition does not depend upon an insufficiency of food, but upon an insufficient intake of fluid and defective excretion of waste products by the kidneys. The fever is high and irregular, and the baby shows marked irritability, restlessness, and obvious thirst; there may also be some vomiting and diarrhœa. The condition is due to a too scanty colostrum and a lack of fluid, and the treatment is to give a small aperient dose of castor oil, followed by abundant fluids sweetened with sugar, and perhaps also flavoured with orange juice. This treatment is followed by rapid cure. *Uric acid renal infarcts in the newborn* is a condition which produces similar general symptoms, but in which there is also an incrustation of uric acid crystals within the collecting tubules and on the mucosa of the renal pelvis. Evidence of this local deposit from the concentrated urine will be found on the napkins, which show a brownish-red sandy sediment, and microscopic examination of this will show the characteristic uric acid crystals. The treatment here is the same as for inanition fever: in addition, alkali in the form of sodium citrate, 2 grains every two or three hours, should be given for a day or two. *Edema neonatorum* may be general in feeble premature infants and is then usually fatal, but it is also occasionally met with as a localised condition in babies who appear to be healthy and strong in other respects. Its usual sites are the feet, the lower abdomen, the pubes and groins. There is no evidence of nephritis, neither casts nor albumin being found in the urine. It is easily distinguished from the serious and much rarer condition of sclerema by the good general condition of the baby. The treatment consists in giving, for a few days, an alkaline diuretic such as sodium citrate, and in ensuring thorough evacuation of the bowels.

Pyloric Stenosis is an important and not rare disease of the neonatal period, which is dependent upon a congenital spasm and hypertrophy of the pyloric sphincter. In its usual form it has clinical features which are characteristic. Symptoms first appear in the third

or fourth week of life, after an initial period from birth of good health and digestion. The first symptom is vomiting, which is infrequent at first, but is nearly always forcible and projectile; and this, persisting for a few days, is followed by constipation. For a time the general condition may suffer little; the baby may retain its look of health, be lively and hungry, but sooner or later, wasting becomes evident. In the great majority of cases the baby is a boy. Diagnosis is easily made, and depends upon *seeing* waves of exaggerated gastric peristalsis passing from left to right across the left hypochondrium, and upon *feeling* the thickened pylorus in the right hypochondrium. The symptoms of vomiting and constipation are very common in babies of this age, but it is their sudden and unexplained occurrence after a week or two of smooth progress, and in a boy, that should at once call for an examination of the abdomen. The treatment need not be detailed here, but two points must be emphasised: the importance of early diagnosis; and the importance of continuing breast feeding, as the success of further medical or surgical treatment is much greater in breast-fed babies than in those that have been weaned. The important part of medical treatment is lavage of the stomach once or twice daily. If this does not produce improvement of symptoms in a week, the Rammstedt operation of splitting longitudinally the pyloric muscle should then be performed. The signs of improvement under medical treatment are the reduction of the milk residue in the stomach, the disappearance of constipation, and especially an increase of weight. The majority of cases require operation, but most cases benefit by a few days of medical treatment, which reduces the operation risk.

Hæmorrhagic Disease of the Newborn (Melæna Neonatorum). This is a rare and a special type of gastro-intestinal hæmorrhage. It usually begins on the second and third day with the appearance of a little blood in the stools; this continues and increases until large stools of fluid or clotted blood are passed. The baby rapidly becomes blanched and collapsed, and unless promptly treated, dies in a few days. In some cases the first symptom is hæmatemesis; or hæmatemesis and melæna may occur together. This type of gastro-intestinal bleeding has to be distinguished from the hæmorrhage of duodenal ulcer of the newborn—another rare condition—from umbilical septicæmia, and from syphilitic disease of the liver; also from the hæmatemesis and melæna, where blood is sucked and swallowed from a fissure in the mother's nipple; it differs in its rapid onset, and in the rapidly progressive collapse that follows. The condition is due to a temporary deficiency in the clotting elements in the blood, as the bleeding and coagulation times are much prolonged. The treatment consists in the intramuscular injection of two or three 0.5 c.c. doses of vitamin K; and in the majority of cases the result is immediate cessation of bleeding and rapid recovery. If there has been a great loss of blood before

this treatment has been begun, an intravenous infusion of citrated blood will also be required.

Skin Diseases.—*Skin diseases are not uncommon in the neonatal period, and some may be mistaken for congenital syphilis. The lesions of congenital syphilis have a characteristic distribution, round the mouth, eyes and anus, and in a red, raw condition of the palms and soles; in severe cases, pemphigus may occur. There is, however, a non-syphilitic pemphigus, the bullous impetigo of the newborn, caused by staphylococcal or streptococcal infection. In maternity hospitals such cases must be isolated, as the condition is contagious and may spread and cause serious outbreaks of infection. Pemphigus usually begins as a single focal lesion in the moister areas, the neck, axillæ or groins, followed by the appearance of others in the adjoining skin; flat vesicles form and break down rapidly, leaving raw areas, which may spread and fuse into an extensive exfoliative dermatitis. Prompt treatment can avert this more general and dangerous dermatitis; the use of soap must be stopped; the affected areas carefully washed several times daily with alkaline water; a lotion of corrosive sublimate, 1 in 10,000, applied; and the lesions anointed with pure lanoline. Seborrhœa of the scalp may also occur, and may set up dermatitis of the face and trunk; it is treated in a similar way, only omitting the use of the corrosive lotion. Onychia of the fingers and toes may also happen, and here again the treatment is to avoid irritation, to use frequent gentle washing with warm water, and to apply lanoline. Lastly, the infantile type of urticaria may be met with—an eruption of very small, hard and pale papules on the cheeks, arms and legs. This is a trivial condition, usually associated with some digestive disorder; treatment consists in giving attention to the digestion.*

Icterus Neonatorum.—This is a common condition, and is the result of the destruction of blood that always occurs in the liver and spleen immediately after birth. The hæmolysis, the anæmia and the jaundice are therefore physiological, and no treatment is required. In *icterus gravis* (erythroblastosis foetalis), the destruction of red cells is excessive, and the jaundice and anæmia are severe and may be fatal (*vide* pp. 315, 565).

Other types of neonatal jaundice may accompany the hepatitis of umbilical sepsis or of severe congenital syphilis. And with these may be mentioned the deep obstructive and fatal jaundice of congenital obliteration of the bile ducts.

PART VIII
OBSTETRIC OPERATIONS

CHAPTER XXXIX

PREPARATION FOR OBSTETRIC OPERATIONS —VERSION—FORCEPS

PREPARATION FOR OBSTETRIC OPERATIONS

IT must be clearly understood that although we describe here the details to which attention should be given when operations are performed in the patient's home, we are of the opinion that only operative obstetric treatment of a minor character (forceps at outlet, repair of perineum, etc.) should be carried out in the patient's home. Obstetric operations, like surgical operations, should be performed in an institution unless the patient's condition is so critical that removal to an institution is contraindicated (*vide* Footnote, p. 556).

We cannot go into great detail in describing the following operations—space will not permit of it. In a manual written primarily for undergraduates all we can attempt is to present to our readers a simple description of the operative procedures employed in obstetric practice, with comments regarding the indications and limitations of each operation. This and the succeeding chapter are merely an introduction to Operative Obstetrics, a branch of surgery which, although limited in scope, calls for no less judgment and technical skill than does general surgery or any of the surgical specialities.

It is a simple step to pass from the management of a normal labour to the conduct of an operative delivery by the vagina. The preparation of patient, accoucheur and nurse, the sterilisation of hands and instruments, the employment of gloves and masks described in Chapter XXII on "The Management of Labour" are in every detail the precautions taken prior to any operation. The difficulty about domestic midwifery is that so many improvisations have to be made.

In domestic obstetric practice a kitchen table is an excellent substitute for an operating table, as it is rigid and of more suitable height than the ordinary bed. Underneath the table or bed should be a bath or pail as a receptacle for discharges and used swabs. A sheet of rubber, the end of which projects into the bath or pail, should be placed under the patient (Fig. 265).

The patient should be deeply anaesthetised at the time of the actual delivery in order to remove the perineal reflexes which, if not

abolished, render intravaginal manipulations and extraction of the child more difficult. The choice of anæsthetic is referred to elsewhere (p. 413).

After the patient has been anæsthetised it is undoubtedly of advantage to place her in the lithotomy position and support the legs by means of straps or a Clover's crutch. In this position the field of operation can be finally and more thoroughly cleansed, and the

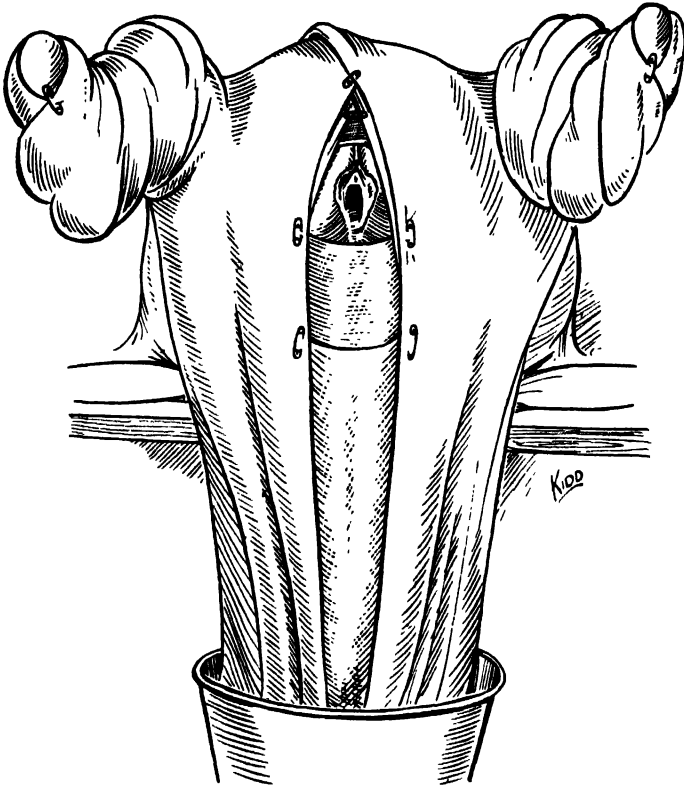


FIG. 265.—Showing patient in position for operation. Her pelvis has been brought to foot of table. Her legs are supported by a Clover's crutch and encased in towels.

operation better carried out than in the lateral position. In country practice where the practitioner may be single-handed and have only a nurse or midwife to assist, it may be preferable to employ the left lateral position (p. 406).

This is a convenient stage for emptying the bladder by catheter. Not only does a distended bladder interfere with the delivery of the child, but, if the child is forcibly extracted, injuries to the sphincter of bladder may readily result (p. 603).

If the pubis has not been shaved this should be done and the vulva

and surrounding skin area cleansed with ethereal soap, followed by a final and thorough bathing of the field of operation with some antiseptic lotion. Lysol is very commonly employed for this purpose, but is inferior to Dettol. Many advocate painting the vaginal entrance with mercurochrome, or tincture of iodine (3 per cent.), but Dettol cream (30 per cent.) is the best (*vide* p. 401).

An important detail, but one regarding which there are differences of opinion, is the washing and *disinfection of the vagina*. We believe this should be done prior to all operations where the presenting part is still high in the pelvis—where the presenting part is at the outlet disinfection of the vagina cannot be carried out. To disinfect the vagina its posterior wall should be retracted and the whole canal washed with a solution of bicarbonate of soda in sterile water to clear away the mucus. The canal should then be washed with ethereal soap very thoroughly and dried. The final application is largely a matter of choice—Dettol, mercurochrome, tincture of iodine.

Following disinfection of vagina ethereal soap or a weak solution of lysol should be poured into the canal to lubricate it and to facilitate the passage of the gloved hand of the operator.

Cleansing and disinfection of field completed, towels and leggings should be placed in position. It will be noted that the obstetric surgeon tries, as far as possible, to follow the same technique as the general surgeon: he walls off the area of operation with sterilised towels or sheets. Admittedly this is difficult to carry out as completely in domestic practice, but it should be attempted as far as possible. Of great importance is the walling off of the anal canal, for the escape of fæces during an obstetric operation, with soiling of the field of operation, may lead to infection.

Finally, a most careful examination of the presenting part, position of the child and the condition of the pelvis should be made before any operation. The obstetric surgeon should ask himself: "Why is it necessary to interfere in this case with the natural process of parturition?" and "How can delivery be effected with the least amount of injury to mother and child?"

We cannot commend too strongly these words printed in italics. Time and time again major and minor disasters might have been avoided by the operator answering these simple questions before he proceeded to the extraction of the child.

Before proceeding to the particular operation the vaginal orifice and pelvic floor should be very gently stretched by what has been termed *ironing out the vaginal outlet*, if the patient is a primipara; the ethereal soap or weak lysol solution renders this procedure easy. The stretching should be done with both hands. It materially lessens the risk of perineal laceration and greatly facilitates the performance of every internal manipulation, such as rotating an occipito-posterior position, bringing down a leg or performing version.

VERSION

The operation of version or turning is the artificial alteration and substitution of one presenting part for another. Where the head is brought to be the presenting part we speak of "cephalic version," and where the breech is brought to be the presenting part "podalic version."

These alterations of the presentation may be carried out by external manipulations alone, *External version*; or by combined external and internal manipulations, *Bipolar version*; or, lastly, by internal manipulations, *Internal version*. The oldest operation is internal cephalic version, and this dates back to very early times. Hippocrates describes it, and his name is usually associated with the operation. Centuries passed, but no great advance was made until Ambroise Paré (1549) introduced podalic version, or the bringing down of a foot. The credit for introducing external version is generally given to Wigand (1807). The method known as Bipolar version was introduced by Braxton Hicks (1860).

Indications.—The scope of the operation of version has been curtailed greatly in the last twenty years, except with the object of rectifying an abnormal presentation—*e.g.* transverse and breech.

FAULTS IN THE FORCES.—It is very seldom indeed that faults in the forces are an indication for version. By the time one has decided that the forces are insufficient, the operation is contraindicated as the membranes have ruptured, much of the liquor amnii has drained away, and the second stage has been going on for some time.

FAULTS IN THE PASSAGE.—Until comparatively recent years the operation of version was frequently performed for contracted pelvis. But the results were so disastrous to the child that it has been almost entirely replaced by other methods of treatment (p. 528).

FAULTS IN THE PASSENGER OR CHILD.—The faults on the part of the child for which version is specially indicated are malpresentations, and the outstanding one is an oblique or transverse "lie" (p. 476). In discussing this particular "lie" we have pointed out the limitations of version—in the case of an impacted shoulder decapitation is generally a safer procedure (p. 749).

In recent years it has also been found of great advantage to perform external cephalic version in the later weeks of pregnancy should a breech be the presenting part (p. 464). In some instances it is even possible to do this early in labour, provided the mother is a multipara, the child is small, and there is a fair quantity of liquor amnii. Face and brow presentations are very rarely an indication for version; the correct treatment for such malpresentations has been described earlier (pp. 454, 456).

DANGERS THREATENING THE LIFE OF THE MOTHER.—In a number of cases where pregnancy has to be terminated prematurely in the

interests of the mother, as, for example, in cardiac disease, grave eclampsia or renal disease, version is a useful procedure, as a small, non-viable child can be extracted more easily by the breech than with forceps. But on the part of the mother the condition which, above all others, may be most suitably treated by version is *placenta prævia*, although the place of version for this particular complication has been very much limited in recent years (p. 581).

DANGERS THREATENING THE LIFE OF THE CHILD.—We would here remind our readers of the value of version in certain cases of prolapse of the cord. Apart from this complication, only very occasionally is it of advantage to the child to select version.

Methods of performing Version.—As already mentioned, there are three methods of performing version: (1) External version



FIG. 266.—External Version. The operator is pushing down the head with his right hand and pulling up the breech with his left hand.

by external manipulations; (2) Bipolar version or version after the method of Braxton Hicks; (3) Internal version by internal manipulations.

External Version.—This operation is most suitable and successful in the later weeks of pregnancy. From the thirty-seventh week onwards it becomes increasingly difficult, although even early in labour it is occasionally successful if the membranes are unruptured. The two commonest indications are breech and shoulder presentations; but it may be employed with advantage for *placenta prævia* (p. 581).

The exact position of the child is carefully determined by palpation. A hand is then applied over each pole of the foetus, and the foetus is pushed with one hand and pulled round with the other until the breech or the head presents. It is most important that the general attitude of flexion of the foetus should be preserved. Any manipulation which tends to extend the head or trunk should be avoided. Occasionally,

where there is difficulty in carrying out the manipulations, an assistant's hand may be of service.

In many instances version is not possible until the patient is anaesthetised; especially is this the case after the thirty-sixth week. It may be particularly difficult in a breech presentation with legs extended (p. 464) and our readers have been warned of the danger of employing too much force.

Except in the case of placenta prævia (p. 581) it is generally the head that is brought to present where this method is employed.

Having brought the head to present, the accoucheur should push it into the pelvis by suprapubic pressure in order to fix it in the pelvic brim and prevent it returning to its former position. He should also apply pads to the side of the uterus and a binder round the abdomen, if the operation is performed before labour has begun. With an oblique "lie" the foetus very often slips back into its former "lie"; not nearly so frequently does this happen with a breech presentation. In either case, however, he should leave instructions with the nurse that he must be summoned when labour commences, as even at this late date he may be able to perform external version, should the child have taken up its former faulty "lie." If success then crowns his efforts he should rupture the membranes, allow a good deal of liquor amnii to escape, push the head into the pelvis and keep up gentle pressure on the head for twenty or thirty minutes in order to ensure the continuance of a vertex position.

Bipolar Version after the Method of Braxton Hicks.—This procedure is suitable when the os is sufficiently dilated to permit two fingers to pass through, and provided the membranes are still intact or have only recently ruptured. If, on the other hand, the waters have drained away to a considerable extent it is impossible to change the presentation by this method. The ideal time is immediately after rupture of the membranes, with the cervix only partially dilated. Either the head or the breech may be brought to present, but generally the latter is preferred. Occasionally it is possible in a shoulder presentation to push up the shoulder and secure a cranial presentation.

For the carrying out of this method it is a mistake to flex the patient's legs to too great an extent, as this interferes with the turning of the child. In many textbooks an illustration shows the operator as having passed only two fingers into the vagina. Sometimes this is sufficient, but generally the whole hand has to be introduced into the vagina to permit of the fingers reaching the presenting part (Fig. 267). The presenting head or shoulder is pushed up with the external hand, while at the same time the internal fingers manipulate and pull down the breech. Whenever the feet come over the os the operator grasps one, and pulls it through the cervix. The labour should be permitted to run its course. On no account should the child be forcibly extracted through the undilated cervix, as this causes con-

siderable shock to the mother, is liable to result in extensive tears to the cervix and lower uterine segment, and almost certainly the loss of the child (*vide* Delivery of Breech, p. 468). In the event of the head being brought to present, the labour is allowed to run its natural course.

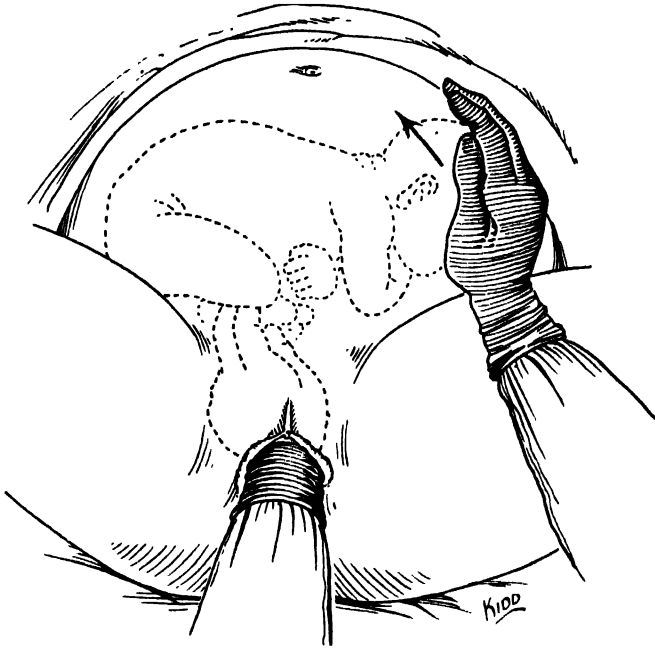


FIG. 267.—Bipolar Podalic Version. This operation, in most instances, can only be completed with the whole hand in vagina as shown here. An assistant or nurse by pressing down the breech may facilitate the operation.

Internal Version.—This, as already stated, is the oldest method. Although originally cephalic version was employed, podalic version is almost universally favoured by modern operators.

The operator passes his whole hand through the cervix, ruptures the membranes if they are still intact and grasps a leg. It is therefore of advantage, prior to inserting the hand, to determine to which side of the uterus the limbs are directed; if to the right, they can be more easily seized with the right hand, while if directed to the left, the left hand is preferable. This detail is of no great importance with the patient in the dorsal position.¹

The operator should desist from all manipulations during a uterine contraction. By employing his other hand externally to pull down or push up one or other pole of the foetus, version is facilitated, but to

¹ As the left lateral position (p. 406) is still employed by many general practitioners in this country mention must be made of the advantage of introducing the left hand in all cases. The left hand, with its back directed to the hollow of sacrum, as it must be, gives the operator special facilities for performing internal version.

enable him to have both hands free the external manipulations may be carried out by an assistant or nurse.

In all instances special care must be taken that a foot and not a hand is brought down. The foot is distinguished by the heel; this is the only landmark which can be relied on. Then it is of advantage to bring down the leg directed anteriorly (*vide* Breech Delivery, p. 468).

Sometimes there is difficulty in getting the head to rise up to the fundus, especially if the waters have drained away. Should this be the case the operator will find it of advantage to attach a loop of gauze to the foot by means of which he can exert traction on the leg,

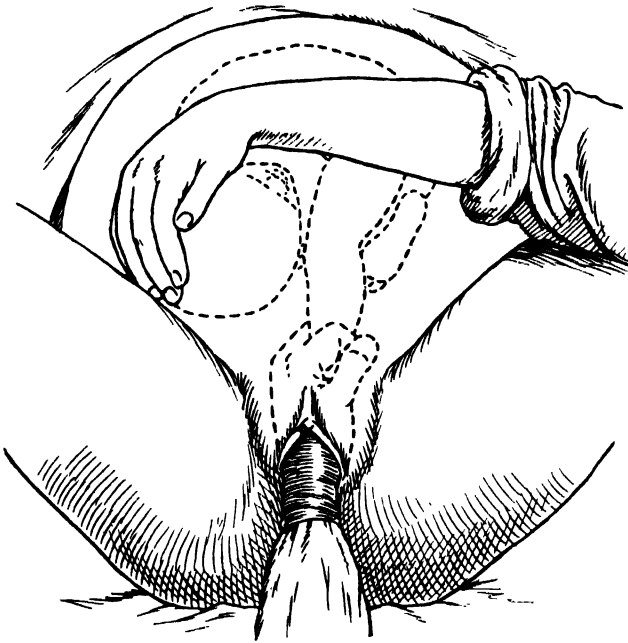


FIG. 268.—Internal Version. The operator has grasped the anterior leg, and it will be observed that he has done so with his left hand, because this is the one most suitable, as the child's limbs here are situated on the left side of uterus. His right arm is not shown. The upper arm shown is that of an assistant.

while at the same time with the other hand in the vagina he dislodges the head. There is considerable risk if this manœuvre is employed by an inexperienced operator (*vide* Rupture of Uterus, p. 600).

If an arm is prolapsed, as is not infrequently the case in shoulder presentations, a loop of gauze should be applied round the child's wrist and the operation carried out as already described. The object of this device is to maintain the arm closely applied to the side of the child, and so facilitate the extraction of the after-coming arms.

In all cases after internal version it is advisable to give the child a few minutes to recover before it is extracted. The manœuvre of internal

version appreciably disturbs the foetal heart, and if extraction is proceeded with immediately this may just turn the scales against the child.

The procedures employed to extract the child after podalic version are described in connection with the delivery of the breech (p. 468).

The operation becomes increasingly difficult and dangerous if the waters have long drained away and a shoulder is fixed in the pelvis ("impacted-shoulder presentation"). As already pointed out, the best treatment in such cases is decapitation (p. 749).

OBSTETRIC FORCEPS

There is no more interesting chapter in the history of medicine than that which relates to the invention and evolution of the obstetric forceps. It is, however, impossible in a work of this size to do more than refer to the invention and to one or two of the important modifications made in the original instrument. The monograph by Aveling¹ is particularly interesting. The most recent and complete history is that by Das.²

The obstetric forceps was invented by Chamberlen. The Chamberlen family fled from France at the time of the Massacre of St Bartholomew. William, the founder of the family, landed at Southampton in 1569, proceeded to London and soon became a most successful practitioner there. It is very doubtful, however, if he was the inventor of the instrument. The probability is that the credit is due to his son, Peter, although other members of the family contributed to the improvement of the instrument. For several generations the family occupied a very prominent position in medicine, especially in obstetrics, in London. A number of them were Court physicians. They were, however, of a peculiarly commercial turn of mind, for, to their disgrace it must be mentioned, that for nearly a hundred years they kept the instrument a secret. Further, they attempted, more particularly Peter, the grandson of William, to secure the control over the granting of licences to midwives, for which he was to receive a royalty. The last of the family was the younger Hugh, who died in 1728. He seems to have been a man of great culture, and more public-spiritedly inclined than were his forebears. During his lifetime the secret gradually leaked out and before his death was quite well known.

The forceps devised by Chamberlen had straight blades, and there was only one curve—viz., the cephalic curve (Fig. 269). It had a lock of the pin pattern still present in the French forceps. The lock as seen in the English forceps was the invention of Smellie, probably the most distinguished practical obstetrician that Britain has ever produced. Born in Lanark in 1697, he practised there for a number

¹ *The Chamberlens and the Midwifery Forceps.* London, 1882.

² *Obstetric Forceps: its History and Evolution.* Calcutta, The Art Press, 1929.

of years, and later went to London, where he formed one of a number of keen young teachers who attained great distinction ; these included William Hunter and Monro the Younger.

Smellie does not deserve, as some have claimed, the credit of

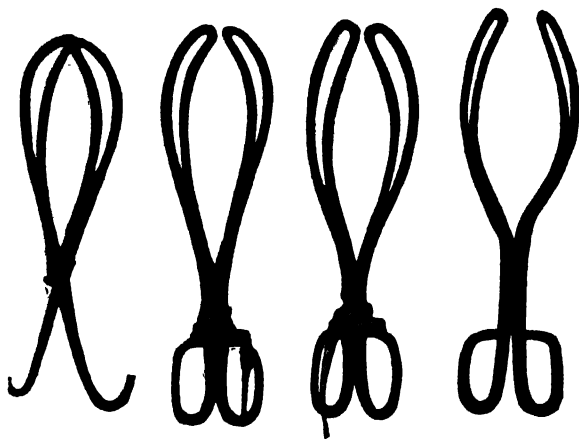


FIG. 269.—Chamberlen's Forceps, which had only a Cephalic Curve. (Aveling.)

introducing the first great modification in the instrument—viz., the second or pelvic curve (Fig. 270). This improvement was introduced by Levret in 1747. By this modification the blades conform directly to the curve of the pelvis.



This portion of the blade shows the pelvic curve.

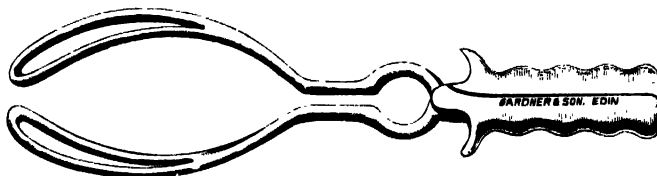


FIG. 270.—Anderson's Forceps, which combined the ring at the end of the shanks introduced by Barnes, and the shoulders at the top of the handles introduced by Simpson.

Many minor modifications succeeded Levret's, but there was no great improvement until a hundred and thirty years later, when Tarnier, in 1877, introduced the axis-traction rods. Many attempts had previously been made to devise an instrument by means of which the accoucheur could exert traction *in the axis of the pelvis*, for it was

always felt, even with Levret's forceps, that this was impossible when the head was situated at the pelvic brim.

There are to-day many modifications of Tarnier's instrument. The one most familiar to the students of Edinburgh and Glasgow is Milne Murray's pattern (Fig. 271), in daily use in our maternity

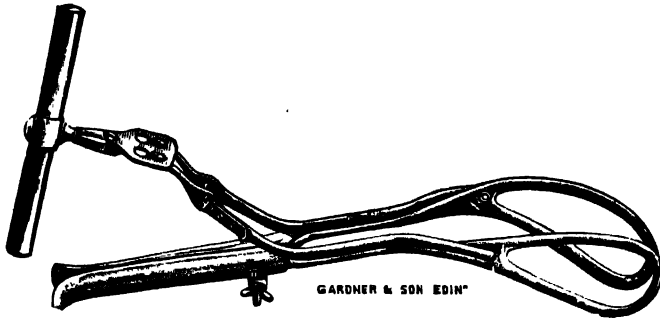


FIG. 271.—Milne Murray's Axis-traction Forceps. The most modern type has the detachable rods which fit into slots at the lower end of the fenestra of the blades.

hospitals. It will be seen from the figure that the blades are curved to adapt themselves to the side of the child's head (cephalic curve), and also curved antero-posteriorly, to adapt themselves to the conformation of the pelvic cavity (pelvic curve). It will also be noticed that *traction rods* are attached to the lower angle of the fenestra of each

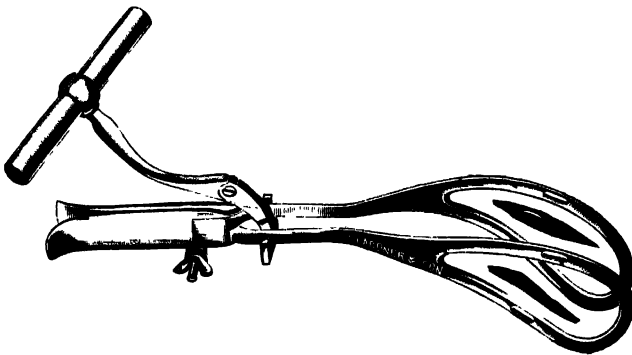


FIG. 272.—Haig Ferguson's Axis-traction Forceps, showing a removable Traction Handle in Position.

blade, run down behind the shanks, and finally are bent backwards, and that to these traction rods is attached a handle, by means of which force exerted on the blades grasping the child's head can be directed in the axis of the pelvis.

The mathematics of the axis-traction forceps were worked out by Tarnier and Milne Murray, who proved that axis-traction forceps of the Tarnier type is the best for traction on the head at the pelvic brim or situated high in the cavity. But, as the "high forceps"

operation is now looked upon with disfavour except in very special circumstances, the arguments in favour of employing axis-traction forceps as a routine cannot now be sustained.

A useful forceps which can be employed either with or without the traction handle was designed by the late Haig Ferguson (Fig. 272). The instrument is shown in the accompanying illustration. His device is similar to that suggested by Neville, of Dublin, and others; it is very simple and easy of application. For many years the writer used Neville's forceps. Neville's and Haig Ferguson's forceps are adapted mainly for traction in the cavity and at the outlet—with very few exceptions, the only situations where forceps should be used.

It is generally stated that the obstetric forceps has five actions: (1) tractor: (2) compressor; (3) lever; (4) stimulator of uterine

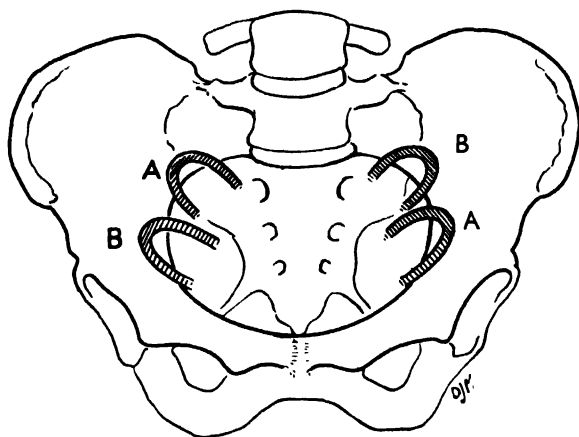


FIG. 273.—Showing the Range of Safe Position of the Blades relatively to the Pelvis.

contraction (this action is referred to as the “dynamic” action, and is frequently observed when forceps is applied to the head at the outlet—the blades stimulate the pelvic reflex and bearing-down efforts); (5) rotator in occipito-posterior or mento-posterior positions.

The really important action of the forceps is that of a *tractor*. The instrument is designed to pull the child's head out of the pelvis. The amount of traction which can be exerted by the forceps is enormous; but, as a rule, the operation is being badly performed or the conditions are unsuitable when extreme force is employed. As regards the *compressor action*, this is slight if the blades are applied accurately to the sides of the child's head (Fig. 274); but it becomes extreme if the blades grasp the head obliquely (Fig. 275) or antero-posteriorly (Fig. 282). Most of the injuries done to the foetal head occur with this oblique or antero-posterior grasp. The *lateral lever action* referred to is of comparatively little consequence, and is employed only occasionally and to a very slight extent. Finally, as regards forceps,

as a *rotator* in occipito-posterior and mento-posterior positions, we think it preferable to correct the head prior to applying forceps (pp. 446 to 448). Kielland has devised a forceps specially suitable for the purpose of rotation, but it is only safe in the hands of expert obstetricians.

Position of Blades relative to Pelvis and to Fœtal Head.—The ideal position for the blades of the forceps *qua pelvis* is in the transverse diameter of the pelvis. There is, however, a range of movement (Fig. 253), but this is limited to the sacro-iliac synchondrosis behind and ilio-pectineal eminence in front—viz., the oblique diameter of the pelvis. A greater range of movement, where the blades lie in the antero-posterior diameter, is dangerous, because the soft parts over the promontory of sacrum may be injured very easily.

As regards the child's head, the ideal position is shown in the accompanying figure (Fig. 275). The blades lie along the sides of the

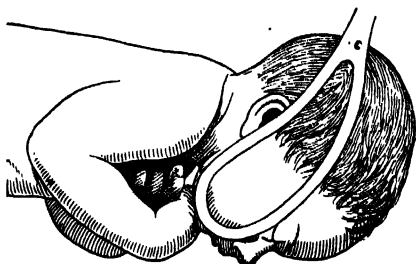


FIG. 274.—The Ideal Position of the Blades with respect to the Fœtal Head.

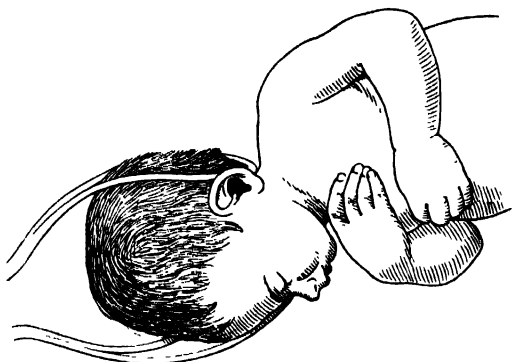


FIG. 275.—Oblique Grasp of the Head, showing the Position of the Blade over Occiput and Sinciput respectively.

child's head in a line running from the point of the chin to a point between the anterior and posterior fontanelles, but rather nearer the latter. With the head low in the pelvis and its antero-posterior diameter lying in the antero-posterior diameter of the outlet it is a very simple matter to place the blades in the ideal position *re fœtal head* and *re pelvis*. In cases of oblique or "deep transverse arrest"

at outlet (p. 448), however, the head is bound to be grasped unfavourably if forceps is applied without previously rotating the head into an antero-posterior position.

If the head is high in the pelvic cavity and care is not exercised in placing the blades along the child's head, the forceps introduced to the sides of the pelvis lie obliquely as regards the child's head. To avoid this the blades should be placed in the opposite oblique diameter to that occupied by the head. Still greater is the danger in flat pelvis, where the head lies transversely (p. 514), and where in consequence the blades must grasp the child's head in the antero-posterior

diameter. This is unavoidable; it is the outstanding objection to the employment of forceps in flat pelvis where the head is arrested at the pelvic brim.

Indications for Forceps.—(a) **FAULTS IN THE FORCES.**—Provided there are no definite indications in mother or child calling for interference, forceps should not be employed until the second stage has been in progress for some time. It is generally stated that forceps should not be used when the uterus is exhausted (secondary uterine inertia), but rather opiates should be given, so that the uterus may rest for an hour or so until active contractions return. In ordinary domestic practice this is impracticable; *besides, opiates given in the second stage are dangerous for the child* (p. 416). In point of fact, provided the head is low in the pelvis, there is no objection to applying forceps, when the inertia is only incipient—indeed, forceps is indicated. Every preparation must be made against the possibility of post-partum hæmorrhage, so liable to occur if *secondary uterine inertia* is pronounced; but this condition should not be permitted to develop—it should be anticipated by earlier delivery.

(b) **FAULTS IN THE PASSAGE.**—One of the commonest indications for forceps in this connection is undue rigidity, or, rather, failure of the forces to overcome the rigidity of the perineum. In such cases extraction of the child must be carried out with great caution. Stretching and “ironing out” of the pelvic floor, already referred to (p. 693), is most useful; but on occasions it is preferable to incise the vaginal entrance laterally (Episiotomy, p. 540).

As regards contracted pelvis, it is most important that the limitations of forceps should be fully appreciated; this matter has been already considered (p. 528). As we have pointed out, the operation of forcible extraction with forceps is discouraged by all obstetricians. The glorious, or rather inglorious, days of forceps for contracted pelvis are gone never to return. The treatment of contracted pelvis has been limited very largely to “trial of labour” and Cæsarean section (*vide* p. 528). *The head must not be dragged through a deformed pelvis by extreme force.*

Forceps should never be employed to pull the head past a tumour. It may only be employed in such a complication after the tumour has been pushed out of the pelvis (p. 551).

(c) **FAULTS IN THE CHILD OR PASSENGER.**—Here are included cases in which the child's head is unusually ossified or large (except malformation such as hydrocephalus), and occipito-posterior and face positions where these cannot be rectified manually. Further, as pointed out (p. 473), forceps is most useful for the delivery of the after-coming head in breech presentations should difficulty be experienced. We have seldom found forceps of any value in delivering the breech arrested at the outlet.

(d) **DANGERS THREATENING THE LIFE OF THE MOTHER.**—Under

this heading are included such conditions as eclampsia, heart disease, advanced phthisis or any other serious maternal complication necessitating interference. The delivery is a comparatively simple matter if the head is low in the pelvis ; but if the cervix is not fully dilated and has to be manually dilated, the delivery may be difficult ; furthermore it may induce a considerable degree of shock—a most serious complication in conditions above mentioned.

(e) **DANGERS THREATENING THE LIFE OF THE CHILD.**—In ordinary prolonged deliveries, if the foetal heart-rate steadily falls to round about 110 to 100, forceps should be applied. Expulsion of meconium is also an indication (p. 429), but before this occurs the foetal heart is generally affected. If the child is to be saved under the circumstances mentioned extraction must be fairly rapid, as its circulation is already impaired ; consequently, should the patient be a primipara, episiotomy (p. 540) is advisable.

As pointed out in connection with other complications, such as a lateral placenta prævia or prolapse of the cord, the judicious employment of forceps may save a child who might otherwise be lost.

Conditions which must be fulfilled if Forceps is to be Employed.—

(1) **THE OS MUST BE FULLY DILATED.**—It is very dangerous to apply forceps prior to full dilatation of the os. Not only is there danger of severe cervical laceration, but the blades reflexly stimulate the cervix, and this narrows still further the cervical canal. If it is necessary in the interests of the mother to deliver with forceps before the os is fully dilated, complete dilatation should be brought about manually or the cervix should be incised before the instrument is applied. These operations should only be performed by the experienced obstetric surgeons.

(2) **THE MEMBRANES MUST BE RUPTURED.**—It is obvious that this is necessary.

(3) **THE PRESENTATION MUST BE A SUITABLE ONE.**—Forceps may be applied in vertex and face presentations and in delivery of the after-coming head.

(4) **THERE MUST NOT BE TOO GREAT DISPROPORTION BETWEEN THE HEAD AND THE PARTURIENT CANAL.** This matter has been fully discussed elsewhere.

(5) **THE HEAD MUST BE IN THE PELVIC CAVITY.**

LOW FORCEPS OPERATION

The patient being anæsthetised is placed in the lithotomy position, with the pelvis brought to the end of the table or the edge of the bed. Before introducing the forceps the operator should examine the position of the head. *It is surprising how often an occipito-posterior position of the vertex is overlooked.* Having determined with exactness the position of the head, the operator should *take the left blade* in his right hand

(Fig. 276). The fingers of his left hand, placed in the vagina, retract the perineum and guide the blade into the hollow of the sacrum. The blade should be kept closely applied to the child's head and then rotated to the left side of the pelvis and over the side of the child's head. As the head is low in the pelvis there is no difficulty in placing it in the best position as regards the head and the pelvis. Having placed it in

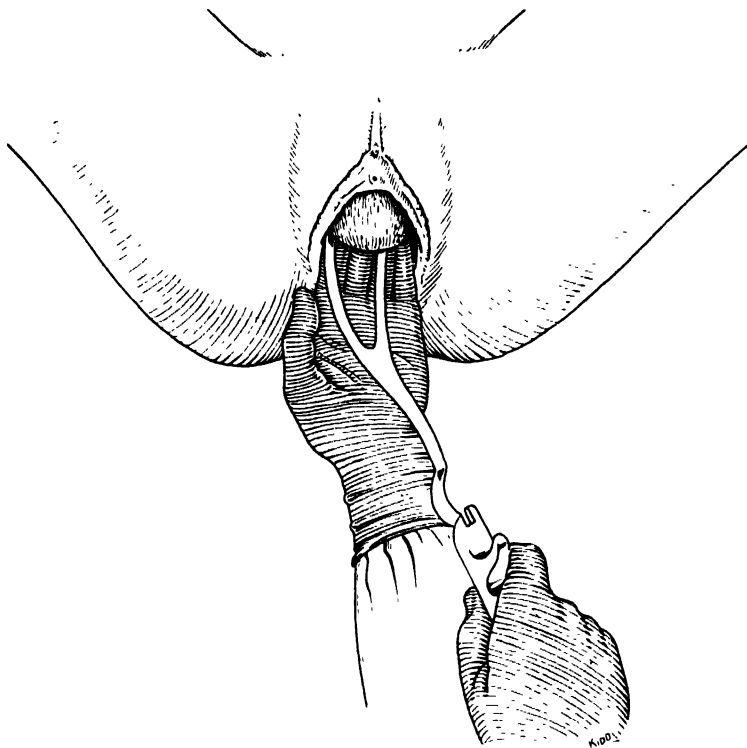


FIG. 276.—Introduction of Left Blade. The foetal head is shown very low in order to demonstrate how blade should be introduced. Under protection of the operator's left hand the blade is carried behind the foetal head into the hollow of the sacrum—then it is rotated and placed in the left side of pelvis.

position the handle should be pressed backwards and held by an assistant.

The second or right blade is introduced in a similar manner (Fig. 277). The operator grasps the right blade with his right hand as before. He directs this blade also into the hollow of the sacrum in front of the first blade retracted by the assistant. He then rotates it so that it occupies the right wall of the pelvis. He should now lock the handles—this is generally a simple matter if the head is low in the cavity. Sometimes a little adjustment is required, and if so it will generally be found of advantage to press both shanks against the perineum so as to tilt the tips of the blades forward.

It will be observed that the introduction of the blades into the hollow of the sacrum prior to rotation to the sides of the pelvis has been recommended. This is simpler than attempting to introduce the blades directly to the sides of the pelvis in the first instance.

No reference has been made to the cervix. If the head is at the outlet of the pelvis the cervix is out of reach and cannot be injured.

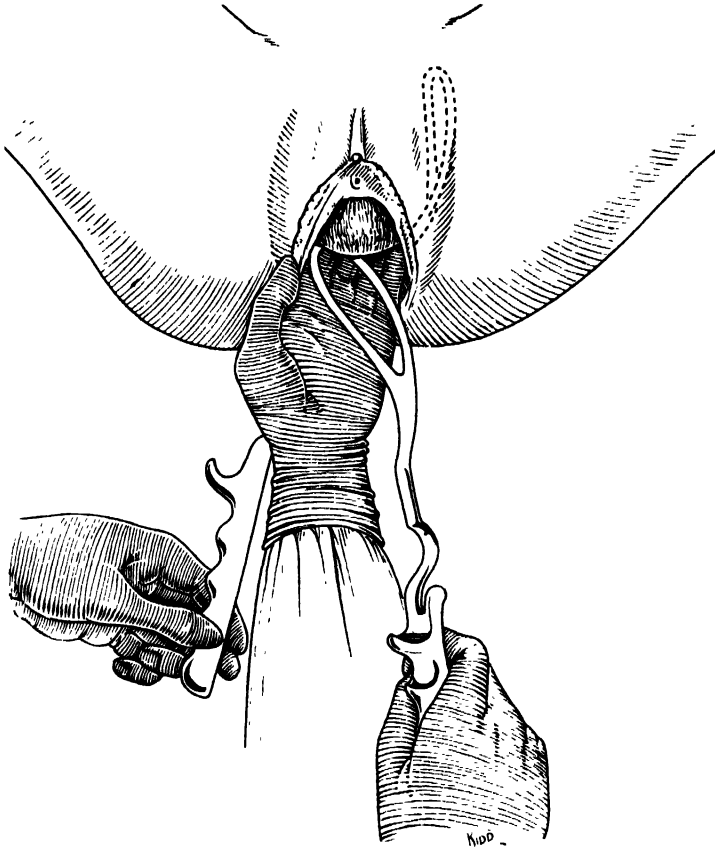


FIG. 277.—Left Blade (dotted) is in Position and is being held there by Assistant. Right Blade is now being introduced—first into hollow of sacrum as before and then rotated and placed in right side of pelvis as shown in next figure.

If, however, the head is high in the cavity very great care must be taken to pass the blades within the cervical ring, which can be easily defined.

Before proceeding to the actual extraction the operator should assure himself that *the instrument is lying correctly re pelvis and head, with the handles in apposition and not too widely separated (which indicates an oblique grasp of the child's head); further, that no mucous membrane of the vagina is nipped by the lock.* He should then exert tentative traction to make certain there is no possibility of the

instrument slipping. This practically never occurs in occipito-anterior positions, although it may easily occur in occipito-posterior positions.

It is advisable in the actual extraction to apply traction during a "pain," then during the interval to loosen the lock so as to relieve compression on the child's head. Traction should be made downwards and backwards in the first instance (Fig. 278) until the perineum is

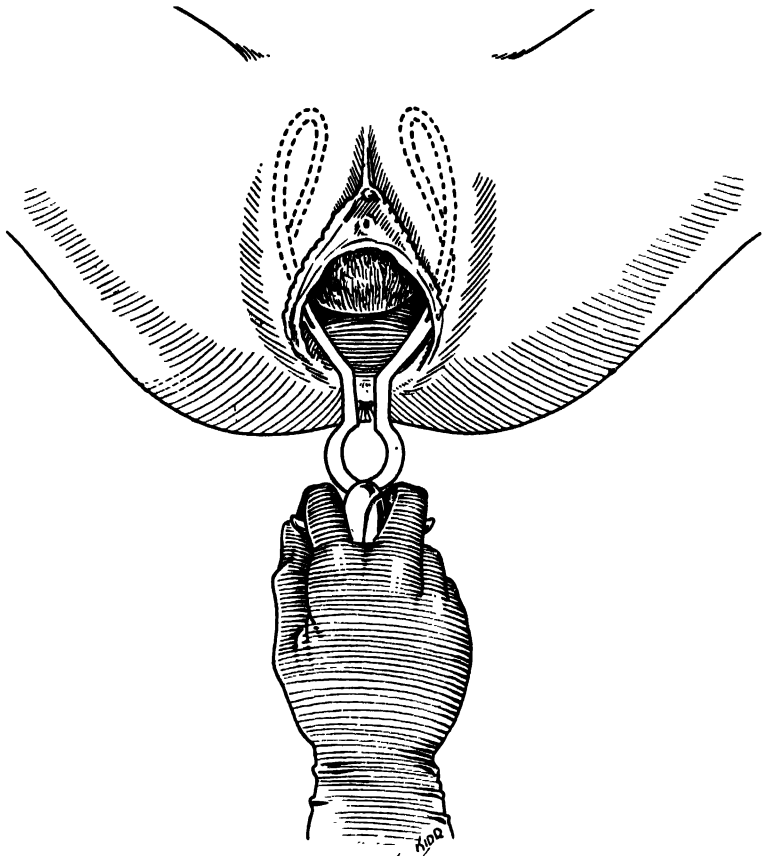


FIG. 278.—Both Blades in Position: the operator is now making traction, with fore and middle fingers over traction bars, at first downwards and backwards as described in text.

well distended, then gradually more forwards and upwards (Fig. 279). Thus the operator by traction makes the head round the symphysis as it does in spontaneous delivery.

In the case of extraction with axis-traction forceps the handles of the forceps simply guide one as to the direction in which to pull. As the head comes down through the outlet and rounds the symphysis pubis the handles tend to pass forwards. The operator, therefore, keeps the traction rods almost touching, but not pressed against the shanks and handles (Fig. 281).

We think it inadvisable to remove the forceps prior to the passage of the head through the vaginal orifice, for with forceps in position the operator has more control over the exit of the head, can lessen somewhat the pressure against the perineum and so diminish the risk of serious perineal laceration. But others prefer to remove the blades before the head is actually delivered: if this alternative is

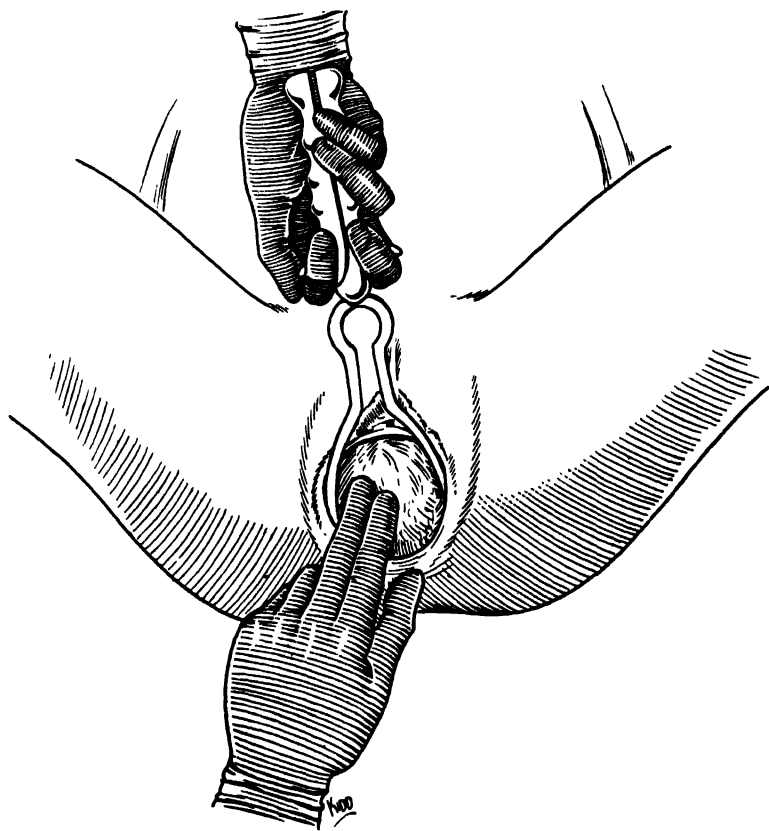


FIG. 279.—Completing the Delivery, as described in text.

employed, there is always the risk that the head may slip back and necessitate re-application of the blades.

One other little point is worthy of attention; the maintaining of the head in an attitude of flexion. If the head is rather small there is a tendency for it to slip within the blades of the forceps and become slightly extended; in such an event the operator should press up the sinciput with the fore and middle fingers of his left hand.

The operator should take a little time to deliver the head, but not too long, for the child may suffer if there is undue delay).

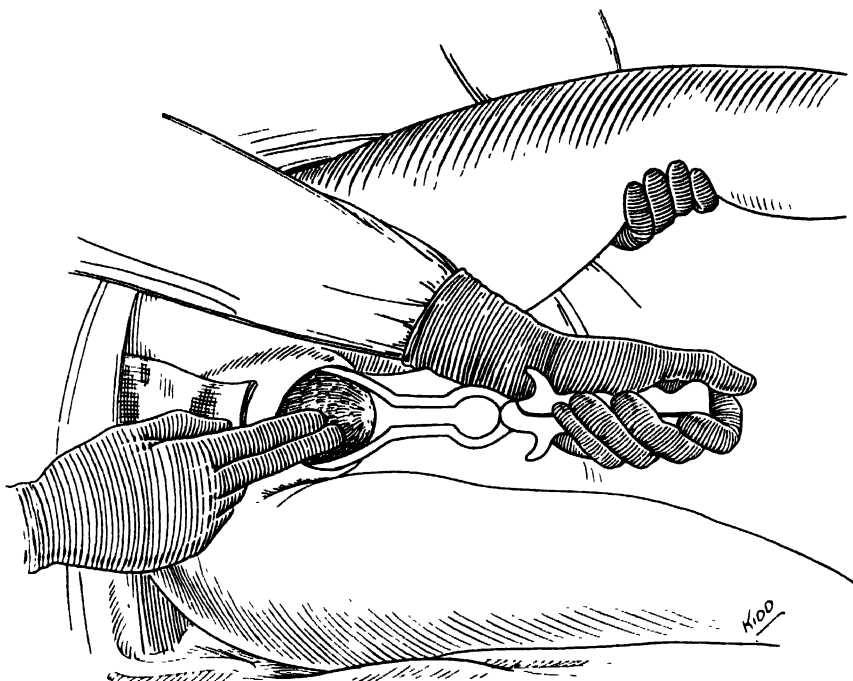


FIG. 280.—Completing the Delivery, with ordinary Forceps, patient in Lateral Position.

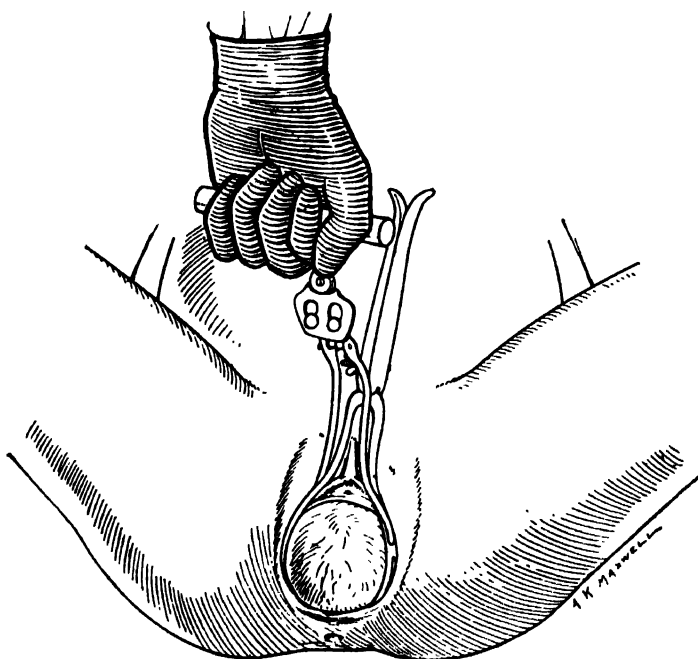


FIG. 281.—Completing Delivery of Head with Axis-traction Forceps, patient in Dorsal Position.

HIGH FORCEPS OPERATION

Head in but High in Cavity.—In this position the head is lying more or less in an oblique diameter, so that the blades, in order to be applied properly to the sides of the child's head, must lie in the opposite oblique to that occupied by the head—*e.g.*, in a first vertex position the blades should lie in the left oblique diameter. They should be introduced in exactly the same way as already described. Great care must be taken in passing them through the cervix, and it is always more difficult to adjust the blades so that they lock satisfactorily. However, if a little time is taken, the blades carefully placed, and the handles pressed well backwards against the perineum, it is usually possible to secure a satisfactory grasp of the head. The injuries resulting to the child from forceps delivery in this type of case are generally due to failure to adjust the blades to the child's head.

To effect delivery greater force is required in the "high forceps" operation, consequently mother and child are more liable to injury.

No matter how carefully the blades are applied, when traction is exerted flexion of the child's head is lessened. This may be only fractional, but

it is just sufficient to render the extraction a little more difficult; therefore forceps should only be employed with the head high in the pelvis when this is absolutely necessary. The abuse of "high forceps" in this country is still very great.

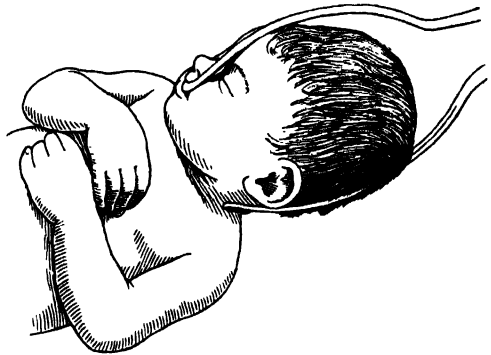


FIG. 282.—Application of Blades of Forceps, with one Blade over the Face and the other over the Occiput (flat pelvis).

Head Fixed but not in Pelvis.—The place of forceps in the treatment of contracted pelvis has altered greatly in recent years. With the excellent results from Cæsarean section and the extremely low mortality and morbidity, both maternal and foetal, from "trial labour" and spontaneous delivery (p. 530) forcible extraction with forceps has gone out of favour and is condemned by all obstetric surgeons. We have attempted in a previous chapter to indicate the cases in which forceps may be justified; but we would again point out that only moderate traction should be employed. The operation for this condition requires great judgment, and this implies considerable experience in the refinements of obstetric practice. We deprecate very strongly indeed the attitude of the few who to-day, in a spirit of boastfulness, claim that they can drag the child's head through a pelvis extremely contracted. Undoubtedly with this powerful instrument delivery can often be

accomplished—but *what about the injuries inflicted upon mother and child?* The foetal mortality and morbidity is enormous.

The employment of forceps in contracted pelvis, for the exceptional case in which it may be justifiable to assist the head through the pelvic brim, is an operation for experts, and very rarely indeed is it employed by them.

FORCEPS DELIVERY IN SPECIAL CONDITIONS

Persistent Occipito-posterior Position.—We have already referred to the desirability of correcting this position prior to the application of forceps (p. 446). Unfortunately, however, this is not always possible,



FIG. 283.—Forceps in Persistent Occipito-Posterior Position of Vertex or Face to Pubes.

with the result that the head has occasionally to be extracted in the occipito-posterior position, or, as it is often termed, “face to pubes.”

The blades are introduced in the manner already detailed (Fig. 283). They are very apt to slip over the occiput.

The delivery should be modelled on the movements which the head takes when spontaneous delivery “face to pubes” occurs (p. 442).

Traction should be made downwards and backwards, then more and more forwards until the occiput is born. The face is then brought down from behind the symphysis pubis. In carrying out this manœuvre the sinciput in the region of the anterior fontanelle and forehead is pressed against the symphysis pubis, whilst the occiput is gradually pulled over the perineum.

It is obvious that in this delivery there must be great compression of the head. It is little wonder, therefore, that the foetal mortality (immediate and late) is relatively high (*vide* p. 445).

Kielland has devised a form of forceps with straighter blades and other slight modifications. It is claimed that by means of it the head can be more easily rotated. For the expert it is a useful and safe instrument. The uninitiated, however, may bring about rotation of head and leave the back still posterior, with disastrous results to child.

Face Presentation.—Forceps may be employed in face presentations with very satisfactory results, provided the head is well down in the pelvis and the chin is forwards. The position of the blades in a facial presentation is shown in the illustration (Fig. 284). The manner in which they are inserted and placed over the sides of the face is, for the most part, the same as has been already described in

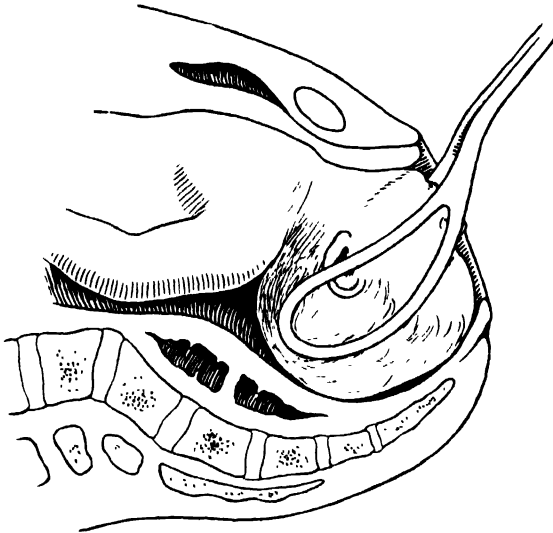


FIG. 284.—Forceps in Face Presentation (mento-anterior).

ordinary vertex presentations. Special care must be taken not to injure the face.

In delivering the head one must prevent the too early descent of the occiput, for if this occurs before the chin comes below the symphysis pubis the head becomes impacted. The chin should be pulled round the symphysis pubis and the occiput slowly dragged over the perineum. In other words, one should imitate as far as possible Nature's method of effecting spontaneous delivery (p. 452).

As regards mento-posterior cases, it has already been pointed out that traction with forceps occasionally results in rotation of the chin forwards, even when this seems hopeless (p. 455). Prior, therefore, to perforation, the *dernier ressort* in such cases, forceps should be applied and moderate traction exerted; not with the idea of delivering the head as a mento-posterior, for this is impossible, but in the hope that rotation of the chin forwards may take place.

Brow Presentation.—Forceps should not be employed in brow

presentations until the brow has been converted into a face or vertex position (p. 456).

After-coming Head.—We have already emphasised the advisability of having forceps ready in breech presentations. It is infinitely better to deliver by forceps rather than by exerting great traction on the trunk, if difficulty is experienced in extracting the after-coming head (p. 473).

In carrying out the operation the trunk of the child should be pulled well forward, as shown in the illustration (Fig. 285), for by so

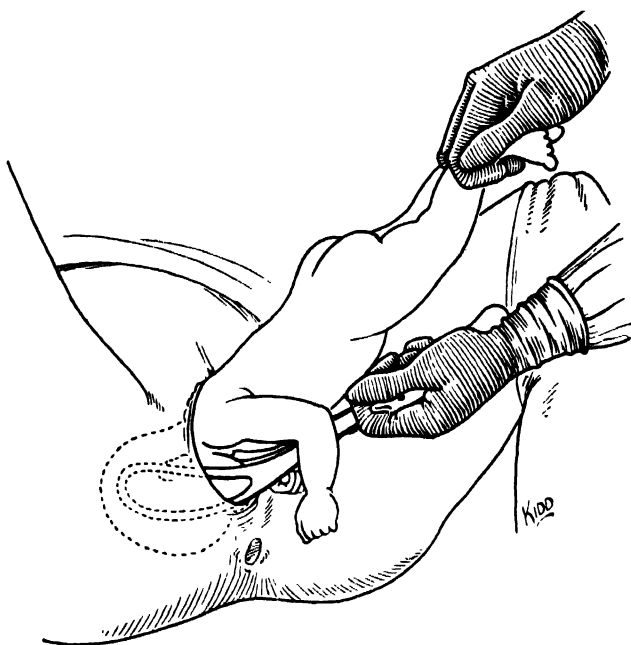


FIG. 285.—Forceps applied to "After-coming Head." Note that the instrument is applied along the ventral aspect of the child, thus maintaining the head in an attitude of flexion.

doing the operator can readily pass the blades along the sides of the child's head. *The forceps should lie along the ventral aspect of the child.* The trunk and forceps should be carried up towards the mother's abdomen in the extraction of the head.

By employing forceps for the delivery of the after-coming head, two essentials for the safety of the child—viz., preservation of flexion, and rigidity of trunk and head—are ensured without exerting any traction on the neck. Secondly, with forceps there is no chance of making the most serious mistake of carrying the trunk of the child up towards the abdomen of the mother too early—a mistake frequently made (and a most disastrous one for the child) when the ordinary method of manual traction on the trunk is employed.

CHAPTER XL

SYMPHYSIOTOMY, CÆSAREAN SECTION, ETC.

Symphysiotomy—Cæsarean Section—Induction of Premature Labour—Induction of Abortion—Vaginal Hysterotomy or Cæsarean Section—*Accouchement Forcé*—Craniotomy, Decapitation, Evisceration, Cleidotomy.

SYMPHYSIOTOMY—PUBIOTOMY

Symphysiotomy.—The operation was first performed in 1777, by Sigault, of Paris. He suggested it some years before, whilst he was a student. It soon fell into disfavour in France, but lingered on in Italy. It was revived by Morisani and some French obstetricians, notably Pinard, towards the end of last century, and for a time was very popular. During this period the relative merits of *symphysiotomy* (division of the joint) and *pubiotomy* (division of the pubic bone to one side of the joint) were much discussed. Both operations are now out of favour with the great majority of obstetricians. A few in America and the Continent still believe that in carefully selected cases symphysiotomy has a useful place, and this is the considered opinion of the writer (Munro Kerr) based on personal experience of the operation. It is not shared in by the other authors of this textbook, or indeed by obstetricians in this country: they, however, have not had personal experience of the operation, so their objection to it is theoretical. The difficulty is in selecting suitable cases.

Indications.—When symphysiotomy is discussed, reference is generally made to its employment in “flat rachitic pelvis” and other deformities of the pelvic brim for which condition it is seldom suitable. Where the symphysis is divided for flat pelvis, the gain in the conjugate of the brim, the diameter we wish increased, is comparatively slight. for with even 1·5 inch (3·7 cm.) separation of the symphysis (the maximum of safe separation) the conjugate diameter is only increased by approximately one-sixth of an inch (4 mm.). *Its place is in “generally contracted pelvis,” “kyphotic pelvis,” and other malformations of the pelvic outlet*, because with separation of the pubic bones there is an equal degree of separation of the tuberosities of the ischia—the diameter we wish increased in deformities of the outlet (*vide* pp. 532-534).

Operation.—The operation should not be undertaken by any but the very experienced obstetric surgeon. The actual division of the

joint may be done under local anæsthesia. If, however, extraction with forceps is to follow immediately, a general anæsthetic may be advisable.

The patient being brought to the edge of the table each thigh should be held by an assistant, who, in addition to supporting the leg, keeps up pressure on the trochanter and prevents the pelvic bones being too much separated during the extraction of the child. *It is advisable that forceps should be placed in position on the child's head before the actual division of the joint is made.*

The operator may divide the symphysis or the pubic bone to the side of the joint (pubiotomy), but symphysiotomy is preferable.

The simplest technique is now employed in the division of the

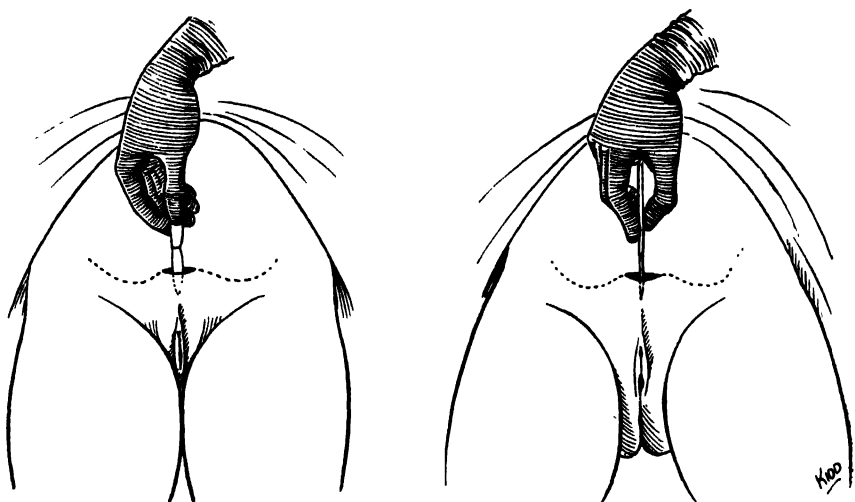


FIG. 286.—Subcutaneous Symphysiotomy as described in text.

joint. The recent discovery by means of radiography that a marked separation of the pubic bones at the symphysis takes place in the later weeks of pregnancy (p. 121) has strengthened the arguments of supporters for the simple operation described below.

A small incision is made at the upper margin of the symphysis. Through it the blade of a knife is pushed down with the flat of the blade against and in front of the joint (Fig. 286). The knife is then turned so that its edge is directed against the joint. The joint is partially divided by the knife. By allowing the legs held by the two assistants to be abducted slightly, the last fibres of the joint slowly tear and division of the joint is completed. By further abduction of the legs the separation of the pubic bones to the desired extent is brought about. Not more than 1.5 inches (3.7 cm.) is permitted; indeed half that distance is generally sufficient. This gives a like amount of separation between the tuberosities of the ischium or transverse diameter of the outlet.

During the extraction with forceps the assistants keep up pressure over the trochanters to prevent undue separation of the pelvic bones.

It is advisable in many cases to perform episiotomy and so lessen the tension on the anterior vaginal wall. Having extracted the child the symphysiotomy and episiotomy wounds are carefully sutured and dressed. A full dose of pituitary extract (1 c.c.) should be administered. The upper margin of the abdominal binder should be applied above the fundus to press the uterus down against the brim of the pelvis in order to control any possible retropubic hæmorrhage.

It is unnecessary to keep the pelvis absolutely rigid. If, however, the operator desires to keep the pelvis rigid, broad strips of adhesive plaster may be wound round the pelvis. The nursing, more especially as regards the toilet of the vulva and bowels, is a little troublesome, but such difficulties can be overcome by having a mattress made (as did the writer) in three sections, the middle section being removed when necessary.

DANGERS OF THE OPERATION.—Reference is frequently made, by those who have no experience of the operation, to subsequent difficulty in locomotion ; the writer has never observed it. Should it occur the pelvis has been too small and the bones have been too widely separated ; in other words, the limits of the operation have been exceeded.

The danger of the operation is injury to the urethra and bladder during extraction of the child, and is specially liable to happen if it is performed for a deformity at the brim—a condition which, as already pointed out, is not suitable for symphysiotomy.

In carefully selected cases where the operation is employed for deformities of the outlet the results, both as regards the mother and child, are most satisfactory and may be quite as good as from Cæsarean section—better indeed in some instances, as where the patient has been long in labour and many vaginal examinations have been made.

Pubiotomy.—Division of the pelvis to the side of the joint by means of a wire saw carried behind the bone is a more complicated procedure. It may be attended by a good deal of retroperitoneal hæmorrhage, and the greater risks of infection of the wound have to be taken into consideration. On the other hand, the urethra is less endangered ; but the danger is very slight unless the operation is unwisely employed for head high in pelvis.

CÆSAREAN SECTION

The operation of Cæsarean section goes back to the very earliest times ; in fact, we have no knowledge as to who was the first to perform it. In pre-antiseptic days, only occasional cases recovered, the majority of women dying as a result of sepsis. A number, however, died of hæmorrhage, because before 1880 the uterus was not stitched.

In 1876, a few years before the modern operation was devised,

Porro reported satisfactory results from removal of the uterus after extracting the child. The stump of the uterus left by Porro's operation was brought through the abdominal wall and stitched or held in position by long pins. This was a great advance.

The names which should be specially associated with the modern operation are those of Kehrer and Säger. The former deserves priority. In 1881 he recommended careful stitching of the uterus. Furthermore, he advocated an incision low in the uterus and directed transversely—the modern lower segment operation (p. 726). Säger (1886) advocated the classical incision (p. 721) and stitching as now employed. Murdoch (Cameron, of Glasgow, also deserves mention. He early appreciated the possibilities which the new technique opened up for the operation, and was the pioneer of the classical operation in this country.

So successful has the operation proved in recent years that its scope has been extended, and to such an extent that at the present time there is the danger that this is being overdone.

Indications.—CONTRACTED PELVIS.—Cæsarean section is indicated where the pelvis is so deformed that the child cannot pass through, or can only pass if extreme force is employed to pull it through. We have explained elsewhere the manner in which the borderline case should be treated ("Trial Labour." p. 529).

It may be taken as a general principle that Cæsarean section should always be performed if the child is alive, and craniotomy if the child is dead; but there are exceptions to this rigid principle. In extreme cases of pelvic deformity it may be impossible to deliver by craniotomy—e.g. if the C.V. is $2\frac{1}{2}$ inches or under—even although the child is dead; while in certain cases in which the child is living, but numerous examinations have been made, forceps employed and the parturient canal probably infected, it is not so certain that Cæsarean section should be selected. We refer to this latter point later (p. 731).

TUMOURS.—The tumours which most commonly obstruct the parturient canal are fibromyomata of uterus and cystomata of ovary.

If a *fibroid tumour* obstructs the passage of the child from the uterus, Cæsarean section followed by hysterectomy should generally be selected; but in a few instances myomectomy may be substituted for hysterectomy. On no account should the child be dragged past the tumour. In a number of cases in which obstruction seems likely the tumour is dragged up in the early stages of labour. The treatment of fibromyomata complicating pregnancy and labour is considered elsewhere (pp. 294 and 549).

As regards *ovarian cystomata* the ideal treatment, if the tumour is recognised during labour (p. 550), is to remove the tumour by abdominal section and deliver the child per vaginum; but in many instances Cæsarean section is advisable. Naturally, if the tumour is recognised

during pregnancy it is removed and the pregnancy allowed to continue (p. 297).

In certain cases of inoperable *carcinoma of the cervix* Cæsarean section with supravaginal hysterectomy is often the safest treatment. This subject is considered elsewhere (p. 541).

Broad ligament cysts, lymphadenomata, osteomata, malignant tumours of rectum, etc., may occasionally necessitate Cæsarean section. They are, however, great rarities.

PRE-ECLAMPTIC TOXÆMIA AND ECLAMPSIA.—Cæsarean section for these complications must be selected with great judgment, for in the vast majority of cases the ordinary remedies employed are sufficient. The cases suitable for Cæsarean section are these in which there is no attempt at labour, and where, after a trial of the ordinary remedies, there is no improvement. The "fulminating" type deserves special consideration (p. 237); in this grave form of eclampsia, progress downhill may be so rapid that there is no time for ordinary medical remedies to take effect.

The mortality is very high with Cæsarean section performed for this condition; but it will always remain high, as only in the grave examples of this disease is the operation advisable.

PLACENTA PRÆVIA.—As far back as 1898 Lawson Tait recommended the operation for this condition. As pointed out elsewhere (p. 583), the great argument in favour of Cæsarean section is that the foetal mortality is relatively small. Until recently the maternal mortality was high, as the operation was employed only in desperate circumstances; but excellent results have been published in the last year or two by a number of experienced obstetric surgeons. The cases suitable for Cæsarean section are fully considered in Chapter XXXIII.

CONCEALED ACCIDENTAL HÆMORRHAGE.—Other procedures are preferable to Cæsarean section in most instances; but in some of the graver forms Cæsarean section, with or without subsequent removal of the uterus, is the best procedure (p. 588.)

CICATRISATION OF VAGINA.—In examples of old cicatrices seriously obstructing the vagina, Cæsarean section is indicated.

RIGIDITY OF CERVIX.—Whether the operation should be more frequently employed for rigidity of the cervix with extremely slow dilatation, if the patient is an elderly primipara, is worthy of consideration; a good deal can be said for its employment in carefully selected cases. Cæsarean section is necessary in some cases following amputation of cervix (p. 541).

RETRACTION AND CONTRACTION RINGS.—This variety of obstruction has been referred to elsewhere. In exceptional cases where an annular constriction interferes with the descent of the presenting part it may occasionally be necessary to perform Cæsarean section (p. 547).

VENTROFIXED UTERUS.—There is a number of cases on record in which a previously ventrofixed uterus (p. 548) has necessitated the

performance of Cæsarean section. One should have no hesitation in selecting the operation if the axis of the canal is so distorted that delivery of the child by the vagina would be attended with great difficulty or danger to the mother and child.

GRAVE DISEASES THREATENING THE LIFE OF THE MOTHER.—Undoubtedly in some cases of this nature—*e.g. cardiac disease* with pronounced failure of compensation—there is less shock from Cæsarean section than from delivery by the vagina. It takes very little time, and so a mother and child who might otherwise be lost may sometimes be saved by this operation (p. 245).

DANGERS THREATENING THE LIFE OF THE CHILD—PROLAPSE OF CORD.—In specially selected cases, for example in pelvic disproportion or if the patient is an elderly primipara, it is justifiable to choose Cæsarean section. We are not prepared, however, to advocate its employment as a routine method of treatment (p. 501).

IMPACTED SHOULDER.—In exceptional cases where the foetal heart-sounds are strong and regular, the operation might be considered if version presented such difficulties that decapitation was the only alternative. The objection to Cæsarean section is that the parturient canal is already infected in such cases (p. 501).

POST-MORTEM CÆSAREAN SECTION.—It is accepted as a rule in obstetrics that no pregnant or parturient woman should be allowed to die without an attempt being made to rescue her child if it is alive. The simplest method of emptying the uterus is to perform Cæsarean section. Generally speaking, the child is lost, but in some instances it has been saved, especially if death of the mother has been sudden. *If the operation is performed just before the mother's death many children can be rescued.*

Preparation of the Patient.—This is the same as for any other abdominal operation (p. 1055).

TIME FOR OPERATING.—Undoubtedly the best time to operate is early in labour; but as one cannot always arrange this beforehand many do not hesitate to perform the operation before labour has started. In multigravidæ there is little objection to this procedure; but in primigravidæ there may be postpartum disturbance from blood pent up in the uterus. In “trial labour,” which has come into favour for slighter degrees of pelvic deformity, the time for the operation, if this becomes necessary, is when progress is arrested (p. 530).

Anæsthetic.—Many operators recommend spinal anæsthesia (p. 420). It favours uterine retraction, so that there is less hæmorrhage and shock. On the other hand, a number of fatalities have been reported; therefore “gas and oxygen” is the safest anæsthetic. *Local analgesia has many advocates in the United States of America and in Canada. Recently it has been very strongly recommended by Marshall¹ of Liverpool.*

¹ *Cæsarean Section: Lower Segment Operation*, John Wright & Sons Ltd., Bristol, 1939.

CLASSICAL OPERATION

ABDOMINAL INCISION.—The incision employed in classical Cæsarean section is a paramedian one of from 7 to 8 inches in length, with $\frac{2}{3}$ below and $\frac{1}{3}$ above the umbilicus. If it has been decided to remove the uterus, the incision should be made lower. The abdominal cavity having been opened the uterus is generally found rotated to the right; consequently, before any incision is made through its wall this slight torsion should be corrected so that the uterine incision may be made

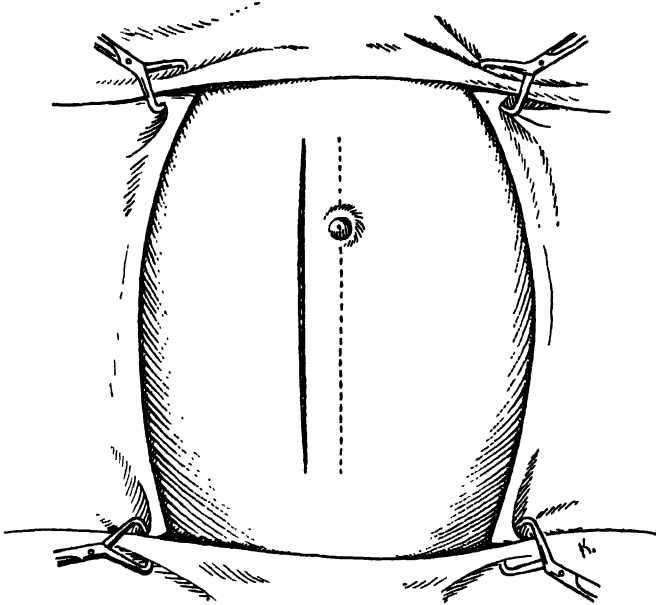


FIG. 287.—Alternative Incisions of Abdominal Wall—continuous line, margin of rectus muscle; dotted line, medial incision.

in the middle line. Gauze should be packed round the uterus before opening into it to prevent contamination of the abdomen from the uterine contents; as a further precaution some operators bring the uterus out of the abdomen before opening it.

UTERINE INCISION.—For classical Cæsarean section the uterine incision employed is a median longitudinal one along the anterior wall. It should be from 6 to 7 inches in length, so that the child can be easily extracted and tearing downwards of the wound into the lower segment prevented. In cutting through the wall there is generally free bleeding, especially if the placenta is situated underneath the incision (this occurs in about 40 per cent. of cases). The bleeding may be lessened by pressing firmly on the uterine wall with swabs just outside the incision. The operator cuts down carefully upon the membranes, which, when reached, bulge through the incision (Fig. 288). Two fingers

are then inserted between the membranes and uterine wall and the incision is enlarged upwards to the necessary extent. The membranes are then ruptured, if this has not occurred prior to operation or whilst the incision was being made. Where the operator finds the placenta underneath his incision he should slip his fingers quickly up between the uterine wall and the placenta, enlarge the incision, push his hand round the placenta through the membranes and seize hold of a leg of the child.

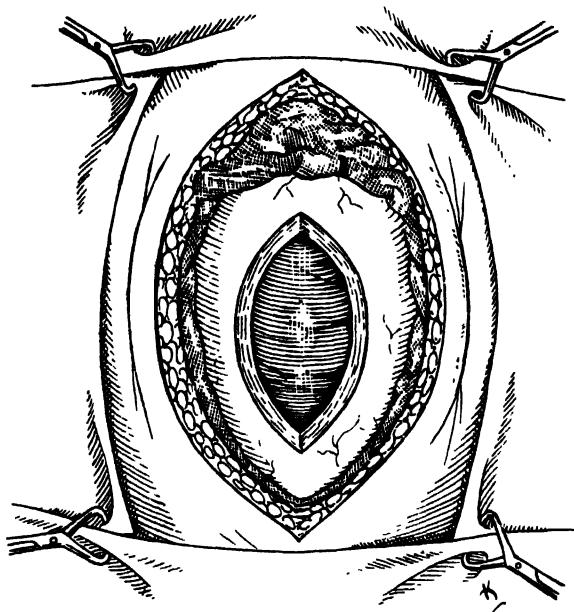


FIG. 288.—Showing Uterus in Abdomen surrounded by Gauze. Incision is in middle line with membranes intact and fetus showing through them.

EXTRACTION OF THE CHILD.—The extraction of the child is best accomplished by seizing a leg (Fig. 289) ; the head is more difficult to grasp. There is never any difficulty in dragging the after-coming head through the incision, provided it is large enough, except in the very rare cases in which the waters have drained away and the "retraction" ring is round the neck of the child. In these latter cases it may be necessary to cut through the constricting ring. Generally speaking, any difficulty experienced in delivering the child is caused by a too small uterine incision. If this mistake has been made a slight extension of the incision upwards gets over the difficulty. It is a mistake to drag the child through a small incision, for the wound extending downwards results in an irregular laceration of the "lower uterine segment" ; furthermore, the child may be seriously injured.

Whenever delivery is completed the umbilical cord should be clamped with forceps and cut, and the child handed over to the

assistant or nurse ready to look after it. The child generally cries very soon, but apnœa may persist in some instances (p. 617).

As the child is extracted the assistant grasps the uterus. The operator then removes the placenta and membranes, and it is of the greatest importance that these should be completely removed. In cases in which labour has been in progress for a long time and there is probability of infection having occurred, some operators prefer to push the placenta and membranes down and instruct an assistant to

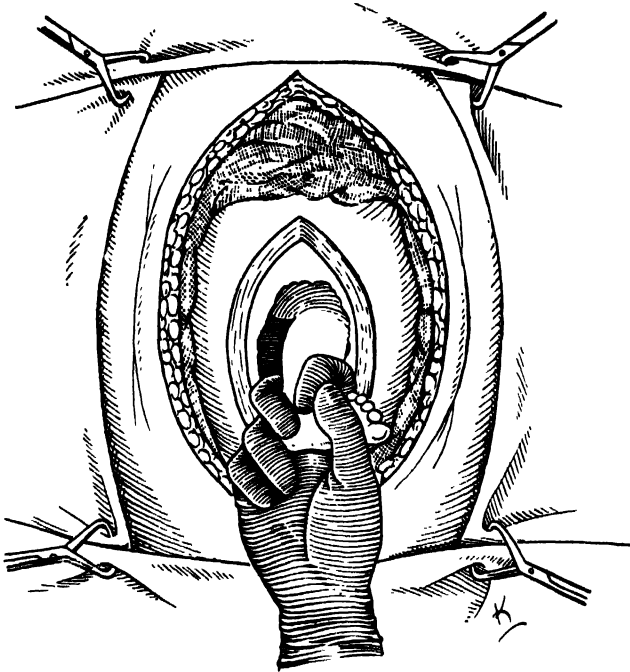


FIG. 289.—Showing Operator extracting Child by pulling on the Leg which he has grasped.

deliver them through the vagina, because if they are dragged up through the uterine wound the infected lower part of the membranes may carry infection into the uterine cavity.

TREATMENT OF THE UTERUS.—There are three courses open to one after extracting the child: (a) retention of the uterus without sterilisation—the true “Conservative Cæsarean Section”; (b) retention of uterus and the sterilisation of the patient by removing a portion of the tubes; (c) removal of the uterus by supravaginal hysterectomy or panhysterectomy.

(a) *Retention of the Uterus without Sterilisation: Conservative Cæsarean Section.*—This is the ideal operation and the one which all up-to-date obstetricians favour. It is carried out as follows. After the placenta and membranes have been removed the uterus is grasped

operable and treatment with radium is not preferred. The steps in the operation are, up to the point of clamping the uterine vessels, the same as those followed in supravaginal amputation. The bladder must now be pushed farther down and the tissues around the cervix separated and all bleeding-points clamped. These clamps must be applied close to the cervix in case of doing injury to the ureters. The upper part of the vagina is now opened into with scissors and completely divided, whilst the assistant secures the wall with pressure

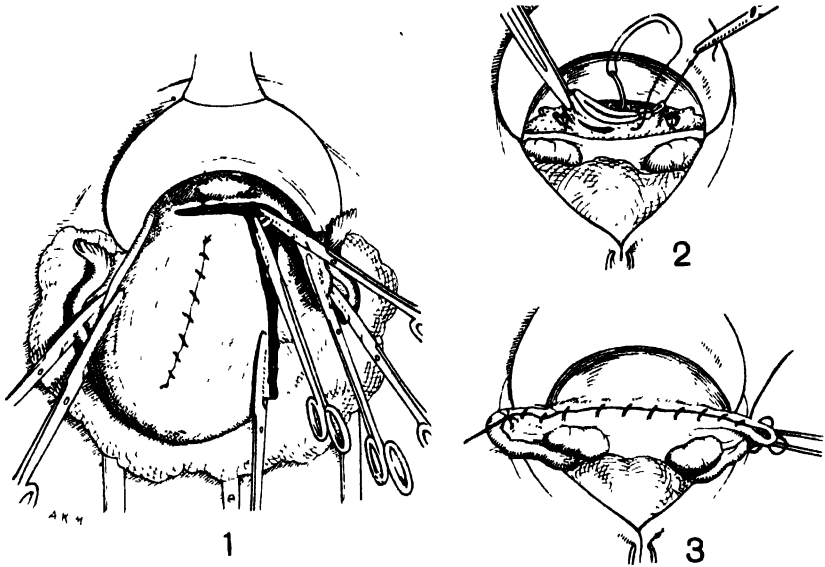


FIG. 291.—Steps in Operation of Subtotal Hysterectomy.

1. Uterus stitched by continuous suture to lessen hæmorrhage; broad ligaments and the uterine vessels clamped; dilated cervix cut across. 2. Cervix stitched. 3. Pelvic floor covered with peritoneum and ovaries conserved.

forceps. All tissues clamped are now ligated and other bleeding-points similarly dealt with. Anterior and posterior vaginal walls are stitched together, special care being taken with the corners, for there is apt to be a little venous oozing there. The raw pelvic surfaces are then covered with peritoneum, as described more fully in the gynæcological section (p. 1065).

CÆSAREAN SECTION BY THE LOWER UTERINE SEGMENT INCISION

A longitudinal incision (6 in.) is made through the abdominal wall in the middle line, the lower end almost reaching the symphysis pubis. The lower end of the wound is then retracted (over a protecting layer of gauze) with a broad retractor (Fig. 292). The rest of the abdominal cavity is protected by packing off the upper portion of the operation area with gauze. A transverse incision is made through the loose

peritoneal covering of the uterus, at the reflexion of the bladder (Fig. 292) which should be pushed down to a slight extent. A similar (transverse)

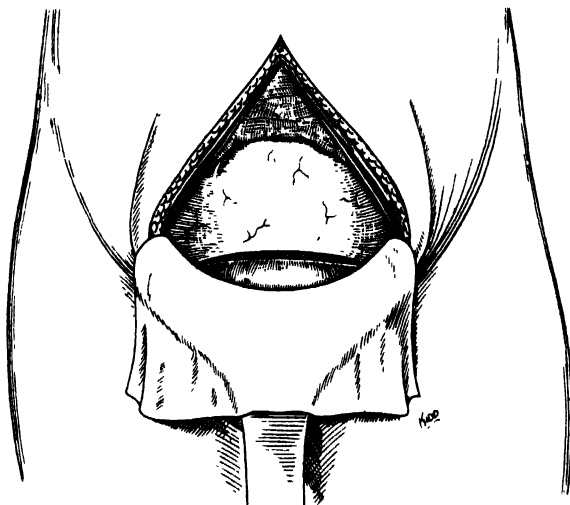


FIG. 292.—Median Longitudinal Incision of Abdominal Wall. Transverse incision through loose peritoneum at reflexion of bladder shown immediately below incision.

incision (Fig. 293) is made through the uterine wall. If the head is not easily accessible, pressure on the fundus through the abdominal wall

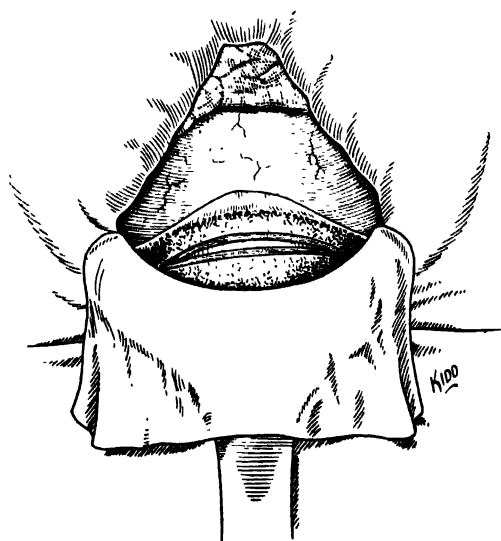


FIG. 293.—Bladder has been pushed down and Upper Flap of Peritoneum pushed up a little. Transverse uterine wound shown.

brings the head into the wound, especially if pituitrin (0.5 c.c.) is injected into the uterine muscle. Willett's forceps, useful for grasping the head in placenta prævia (p. 581), may be employed to extract the head. As an alternative one blade of the forceps may be placed behind the head (Fig. 294) which then generally glides out. If necessary the head may be grasped by both blades and the delivery completed by traction on the head, but this is, seldom necessary.

The umbilical cord is ligated and divided in the usual way.

A self-retaining retractor is now inserted to keep the sides of the abdominal wound apart (Fig. 295). If the cervix is not well dilated, the placenta is delivered

by compression of the fundus through the abdominal wall and traction on the cord. If the cervix is known to be well dilated, the cord, with

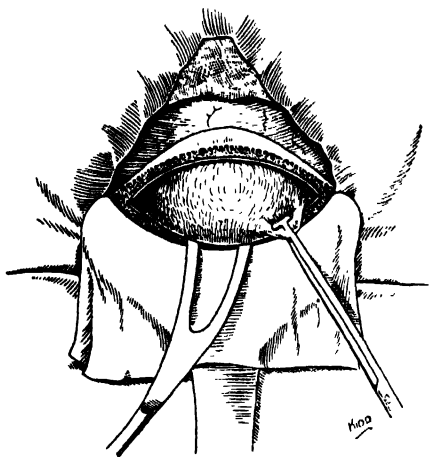


FIG. 294.—Alternative Procedures for extracting Head. On left, blade of forceps; on right, Willett's forceps.

pressure forceps attached, may be dropped back into the uterus—placenta and membranes are expressed by 'Redé's method' after closure of abdomen. *This procedure is especially suitable in infected cases, for if followed the infected membranes projecting through the cervix are not pulled up through the wound.* Most operators, however, deliver placenta and membranes through the wound in all cases.

The ends of the uterine wound are now picked up with fine tissue forceps and the wound closed in layers. The mucous membrane, with the innermost portion of the muscle coat, is sutured with a con-

tinuous fine gut suture, the edges of the mucous membrane being directed inward toward the uterine cavity (Fig. 295). The remainder of

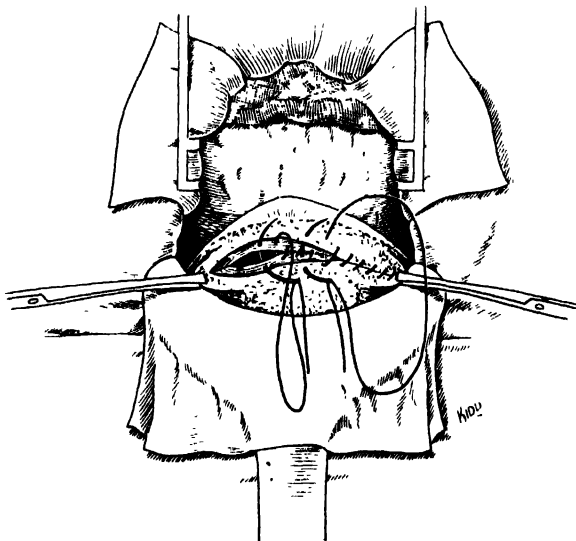


FIG. 295.—Self-retaining Retractor in Position to facilitate careful Suturing of Wound. Left, needle and thread coapt- ing mucous membrane and layer of muscle wall; right, needle and thread coapt- ing main thickness of wall.

the muscle coat is carefully approximated and sutured with a continuous No. 2 gut suture. *Great care must be taken to secure completely the*

lateral extremities of the incision. The bladder which earlier was pushed down a little is now pulled back into position and the upper and lower flaps of peritoneum united (Fig. 296) by a continuous No. 1 or No. 0 catgut suture. The uterine wound is thus completely shut off and covered with peritoneum. All gauze packing is now removed, the abdominal cavity cleared of any blood-clot and liquor amnii, and the abdominal wall carefully closed in layers. An anchored dressing (Fig. 297) or a layer of gauze held in place with collodion is then applied.

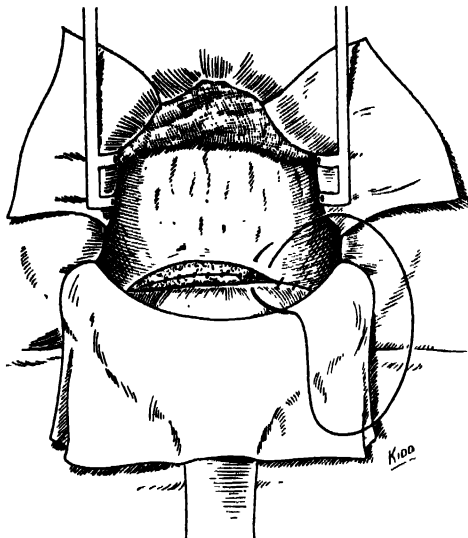


FIG. 296.—Lower Flap (with bladder) and Upper Flap Coapted. When retractor, gauze, etc., are removed the wound sinks down into utero-vesical pouch, and is therefore completely covered with peritoneum.

In recent years there has been considerable discussion regarding the relative merits of the classical and the lower segment incision. Year by year the lower segment incision is coming into greater favour, although a few diehards still favour the older classical

incision. The lower segment operation is employed by practically all the leading obstetric surgeons in America, Germany and other continental countries.

The incision possesses several advantages—(1) the uterine wall in this area is thin; (2) it contains relatively more fibrous tissue; (3) it is much less vascular, and so there is singularly little hæmorrhage during the operation; (4) it is quiescent after delivery; (5) the wound is completely covered with peritoneum, therefore the

development of peritoneal adhesions is prevented; (6) by reason of

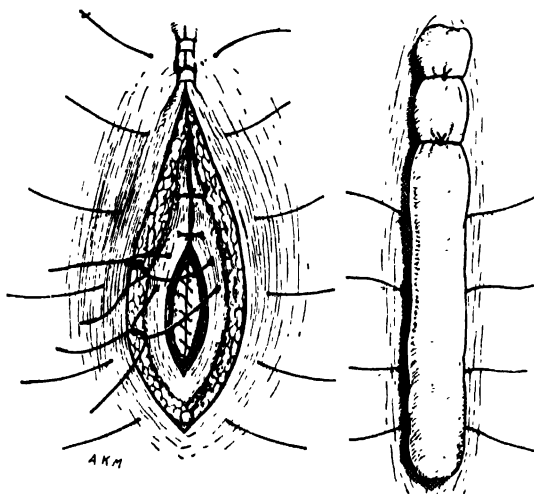


FIG. 297.—Closure of Abdominal Wound. Continuous catgut sutures for peritoneum, interrupted catgut for sheath, interrupted silk worm through whole thickness of wall except the peritoneum. Michel's clips for skin. Two silk worm stitches are shown tied over thin strip of gauze. This is the only dressing.

the site of the wound and the fact that it can be covered by peritoneum the incision is much safer in suspect and infected cases.

We have no desire to overstate the case for the lower uterine segment incision; in point of fact, we admit that in certain circumstances the ordinary classical incision may be better—many operators advise it for placenta prævia, although a number of obstetric surgeons prefer the lower segmental even for placenta prævia (p. 583). The classical incision may be the only choice where a well-developed contraction ring grasps the neck of the child. Then undoubtedly the technique of the classical operation is a little simpler, but that is of no moment to the experienced obstetric surgeon.

The ideal condition for the lower segment operation is the “trial” labour, where the head does not mould sufficiently to pass the obstruction at the brim and the lower segment has become well stretched and thinned out. In most cases, however, the “lower uterine segment” is well enough developed prior to labour to permit of a *transverse incision* in that area. It may not, however, be developed to the extent of permitting a *longitudinal uterine incision* confined to that area. For this reason, therefore, we claim that a *transverse incision* is to be preferred to a longitudinal or vertical incision.

Those who support the lower uterine segment incision do so chiefly because *it has been proved that a stronger scar can be secured in this area*. The reasons why the scar of the classical Cesarean section is liable to give way at a subsequent labour or pregnancy are the following: (1) The uterine muscle fibres during the puerperium are in a state of degeneration. (2) The uterus is in a state of unrest—alternate contraction and relaxation are occurring during the early days of the puerperium, especially during the first twenty-four hours, hence the sutures are being disturbed and dragged upon, and so become slightly relaxed, with the result that the two surfaces of the wound tend to be in less intimate apposition. (3) The necessity imposed upon the surgeon of using his ligatures not only as coaptors but as hæmostatic agents. (4) The sheets of muscle fibre which form the uterine wall are irregularly distributed, so that it is impossible to coapt the muscle fibres exactly. In consequence of this and the previous conditions mentioned, small pockets of blood tend to collect, which in the process of healing are replaced by fibrous tissue. (5) If the placenta is situated on the anterior wall, as occurs in 40 per cent. of cases, the edges of the uterine surface of the wound are difficult to coapt exactly because the interior surface is very friable and contains large sinuses. *Thus there is a tendency to a gutter formation along the course of the wound. This and the fibrous nature of the scar produce a weakness in the wall which in a subsequent pregnancy or labour may give way. If rupture occurs it takes place in the form of a hernia through the uterine wound. Rupture of scar in a subsequent pregnancy or labour where the lower*

segment incision has been employed is almost unknown *if a transverse incision has been employed*.

Maternal and Fœtal Mortality.—CLASSICAL CÆSAREAN SECTION.—There is now available a large amount of material on which to base mortality figures. Many factors influence the mortality, such as the experience, care and skill of the operator, the degree to which asepsis and team work approach perfection and the technique employed under special circumstances. But putting these factors (of paramount importance but impossible to assess) on one side, there are two of outstanding importance: (a) the pathological condition necessitating Cæsarean section; (b) the condition of the patient at the time of operation.

Maternal Mortality.—As regards the influence of the *pathological condition*, it is but natural that the operation shows the lowest maternal death-rate when performed for contracted pelvis—many series of 100 to 150 cases have been reported with no maternal death. When, however, the operation is performed for eclampsia, pre-eclampsia, cardiac disease, one cannot but expect a relatively high death-rate, because these complications are in themselves grave menaces to life.

Turning to the other factor—the *condition of the patient at the time of operation*—the mortality rises as the chances of infection increase until it reaches a point when it is questionable if it is fair to the woman to employ Cæsarean section. Take, for example, the group termed “failed forceps.” Undoubtedly the substitution of the lower segment operation for the classical operation has resulted in a very marked lowering of the death-rate in this particularly dangerous group. Nevertheless, the death-rate is still high—possibly 7 to 10 per cent. Many operators therefore are of the opinion that very few women in this group should be subjected to Cæsarean section even although the child is alive (unless the pelvic deformity is so extreme that craniotomy is impossible). There is another reason why we urge caution in selecting Cæsarean section in this group. The fœtal mortality is very high, and many children, although born alive, die a day or two after delivery as a result of the attempts to deliver with forceps.

Fœtal Mortality.—The fœtal mortality is very low indeed if the operation is performed for contracted pelvis when conditions are favourable. Very striking is the high fœtal death-rate when the operation is performed under unfavourable conditions after a very prolonged labour and especially after failure to extract the child with forceps.

Where the operation is performed for other conditions—*e.g.*, eclampsia, placenta prævia, cardiac disease, etc.—the fœtal death-rate is high, but not nearly so high as when more conservative measures are employed.

LOWER SEGMENT OPERATION.—*Maternal Death-rate.*—The death-rate is much lower for the lower segment operation, *more especially*

in suspect or infected cases. When attempts are made to assess mortality rates of the two operations one has to remember that the lower segment technique is employed by expert operators whose results will naturally be better than those secured by individuals who only occasionally perform Cæsarean section.

Fœtal Death-rate.—There is no evidence that the foetal death-rate is lower with the lower segment operation. In point of fact it may be slightly higher, as extraction of child, unless the operator has had considerable experience of the operation, is more difficult in the lower segment operation than in the classical operation.

INDUCTION OF PREMATURE LABOUR

This most useful operation is peculiarly associated with British obstetrics. In the year 1756 there was a meeting in London of the most distinguished obstetricians of the day to discuss the morality of induction of premature labour in contracted pelvis. The finding of the meeting was in favour of the operation, and shortly afterwards Macauley performed it for the first time. French obstetricians were opposed to the operation; indeed, it was not until 1831 that it was performed in that country. Even to-day neither they nor any other country favour the operation performed for contracted pelvis.

Indications.—The operation of induction of labour should be considered: (1) where the mother's life or future bodily health is placed in great danger; (2) where the foetus at the previous parturition was of very large size; (3) where pregnancy is protracted; (4) where death of the foetus occurs habitually in the later weeks of pregnancy; (5) in certain cases of contracted pelvis. It will be observed that such conditions as cicatricial contractions of the parturient canal, malformations of uterus or vagina, and tumours obstructing the canal are not included, for in none of these conditions is induction of labour advisable.

(1) **WHERE CONTINUANCE OF PREGNANCY PLACES THE MOTHER'S LIFE OR FUTURE HEALTH IN GREAT DANGER.**—This may be caused by many conditions: (a) acute diseases occurring during pregnancy; (b) chronic diseases aggravated by pregnancy; (c) diseases peculiar to pregnancy (*vide* Chapters XI, XII).

Once it has been determined that the pregnancy should be terminated the question to be decided is whether this should be brought about by one of the slower methods, such as *medical* induction, bougies, rupture of membranes, or by Cæsarean section. It may be taken, as a general rule, that where the condition is acute Cæsarean section is preferable; but where the disease is chronic and there is no great urgency the more ordinary methods may be employed.

(2) **FŒTUS OF LARGE SIZE AT PREVIOUS BIRTH.**—Induction of labour is very satisfactory, for not only is the child smaller, but the

foetal head being less ossified moulds better. The operation should be performed in the thirty-seventh or thirty-eighth week.

(3) **PROTRACTED GESTATION.**—The causes of this condition are still undetermined; but it is generally accepted that a pregnancy should not be permitted to continue beyond the fortieth week (p. 183).

(4) **HABITUAL DEATH OF THE FŒTUS IN THE LATER WEEKS OF PREGNANCY.**—This condition has been already referred to (p. 318). It is generally associated with premature degeneration of the placenta, but not necessarily (very rarely in fact) of a syphilitic nature. Unfortunately, we have no exact means of diagnosing when the life of the foetus is in danger. We trust to arrive at the date for induction from the records of previous pregnancies.

(5) **IN CERTAIN CASES OF CONTRACTED PELVIS.**—This is the most common indication, but the real difficulty is allocating the treatment its exact place. The advantages of induction of labour are that the operation can be very easily performed, and that it is associated with a low maternal mortality, provided every care is taken to prevent infection. From the standpoint of the mother it compares favourably with other procedures employed for contracted pelvis, although in recent years the extremely low mortality from the lower segment (Cæsarean section (with or without a trial of labour) has led obstetric surgeons, even in this country, to view induction of labour with declining favour. Unfortunately the foetal mortality is round about 10 to 12 per cent.

The operation is not a suitable treatment for pelvic disproportion in a primigravida (p. 528)—trial of labour with Cæsarean section in reserve is the best procedure.

Factors influencing Fœtal Mortality.—The factors which influence foetal mortality are: (a) condition for which labour is induced; (b) age of the foetus; (c) degree of pelvic deformity; (d) number of foetuses present; (e) method employed for inducing labour; (f) method employed for extracting the child; (g) care expended on the child after delivery.

Condition for which Operation is performed.—It stands to reason that if labour is induced because of disease in the mother the child may have been so seriously affected that it succumbs during, or shortly after, birth. Besides, in many cases it is very premature.

Age of the Fœtus.—The general experience of obstetricians is that induction of labour prior to the thirty-sixth week is disappointing. If possible, therefore, the operation should not be performed until, by careful estimation of the age of the pregnancy, it has been determined that the thirty-sixth week at least has been reached.

Degree of Pelvic Deformity.—As regards this factor a careful estimate of the size of the foetal head and the maternal pelvis is essential (p. 526).

As already stated, most operators of experience are disinclined to employ this operation in a primigravida. They prefer that the first

labour should be a "trial labour"; the operation of induction being employed in subsequent pregnancies if there have been special difficulties at the first parturition (*vide* p. 528).

Number of Fœtuses Present.—In contracted pelvis if twins be diagnosed the pregnancy should not be interfered with, as the fœtuses in a plural pregnancy are smaller than normal and labour very frequently comes on spontaneously before term.

Method employed for inducing Labour.—This does not appear to be an important factor. The method most generally employed in this country until recently was to pass a bougie between the membranes and uterine wall (Krause's method); but a number of operators report equally good results from simple rupture of the membranes.

Method employed for extracting the Child.—The premature child bears operative interference badly. It is advisable, therefore, to avoid forceps delivery and extraction by the breech as far as possible.

Care expended on Child after Birth.—It is unnecessary to emphasise this detail.

Medical Induction.—*This treatment is often effective in starting labour at term; but in the experience of the authors is disappointing before term.* In recent years the induction of premature labour by drugs has been given an extended trial. We have found it uncertain in its action. It is useful, however, in conjunction with one of the operative methods described later. The patient should be given at night castor oil ($1\frac{1}{2}$ to 2 oz.) followed by an enema in three hours; this is followed by three doses of sulphate of quinine (10 gr.) at four-hourly intervals. In the morning, if labour has not started, pituitary extract (0.5 c.c.) at half-hourly intervals up to six doses is administered.

The evidence that the child may suffer from the quinine administered is contradictory. It is questionable if it is of much value.

Operative Measures for Induction of Labour.—The patient should be carefully prepared for operation, anæsthetised, placed in the lithotomy position and a final cleansing of vulva and vagina carried out. These precautions are frequently neglected, because the operation is considered to be of a very minor nature. This is far from being the case—any degree of infection (even death from sepsis) may follow the operation, especially if the bougie method is employed.

Rupture of the Membranes.—This is the oldest method of bringing on labour. It has returned to favour in recent years and in many hospitals has replaced Krause's method, described later. It is simpler than that method and there is less risk of conveying infection upwards from the vagina. The fœtal mortality rate is not higher, and the "latent period," viz., the time between induction and onset of labour, is shorter than with Krause's method.

To ensure a short "latent period" it is most important that a considerable quantity of liquor amnii is withdrawn. An assistant should raise the presenting part with his hands placed above the symphysis pubis. The operator using a large-sized gum-elastic catheter passes it well into the amnionic sac and withdraws 10 to 12 ounces of fluid at least. If the membranes are simply punctured the presenting part may descend and plug up the opening. *It is the withdrawal of liquor amnii that is so important.*

Insertion of a Bougie between the Membranes and the Uterine Wall—Krause's Method.—The cervix should be grasped by a pair of volsella, but no great traction must be made upon it as it is easily torn.

If a finger cannot be passed through the cervix (as is generally the case), the cervix should be artificially dilated, care being taken that the point of the dilator is not pushed through the membranes. A finger should then be passed round the lower segment, and the membranes separated from the lower segment. This favours the onset of labour, and lessens the risk of rupture of the membranes as the bougie worms its way round the membranes; whereas, if the membranes are still adherent when the bougie is inserted it is apt to be pushed through them.

The bougie employed should be a large gum-elastic one, about No. 21 or No. 22. It should be placed ready for use in a tepid solution of weak lysol, which renders it pliant but not too soft. If it is too rigid the membranes are easily ruptured, and if too soft it curls up and cannot be pushed up between membranes and uterine wall (Fig. 298).

It is generally easier to pass the bougie up the posterior wall of the uterus than up the anterior wall. Occasionally its progress is arrested by the placenta, in which case it should be partially withdrawn and directed more to the side or to the front. The bougie should be pushed in to its full extent and sterilised gauze packed into the vagina to keep it in place and to act as an additional stimulant to uterine contraction. Some operators prefer to insert more than one bougie, but one of large size or a small stomach tube is generally sufficient. A number of operators dispense with vaginal packing.

Four accidents can occur with this operation: (1) rupture of the

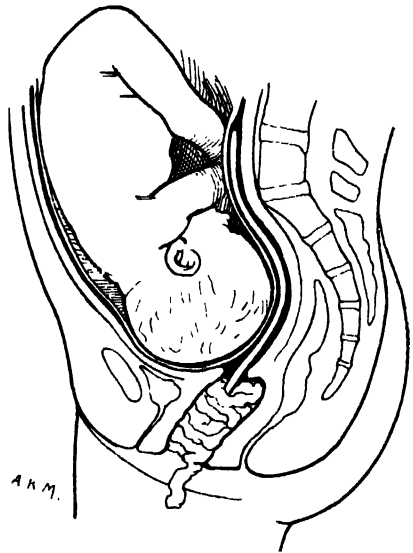


FIG. 298.—Bougie inserted between Membranes and Uterine Wall. Vagina packed to keep it in place.

membranes ; (2) extensive separation of placenta ; (3) infection ; (4) perforation of the uterus.

(1) Rupture of the membranes is of comparatively little consequence, but it very seldom happens if the operation is carried out as described. (2) Detachment of the placenta rarely occurs if the operator desists from pushing up the bougie should there be any opposition to its passage ; it is recognised by free hæmorrhage, but rarely is this serious. (3) Infection is infrequent if every precaution is taken to prepare the patient beforehand. We would point out that as the bougie is inserted between the membranes and uterine wall the risks of infection must be greater than if the membranes are simply ruptured. (4) Perforation of the uterus is avoided by having the bougie not too rigid and by introducing it very gently.

The advantages of this method of inducing premature labour is that the membranes are preserved intact. Its disadvantages are the risks referred to above, and the uncertainty as to when labour will actually commence.

By Hydrostatic Dilators.—The smaller-sized hydrostatic dilators of the pattern of (Champetier de Ribes (p. 742) or Voorhees are employed in some countries ; but in this country we do not consider them suitable for induction of labour, preferring to reserve them for *accelerating* dilatation of the cervix should this be very protracted (p. 543).

There is less objection to the employment of a small balloon, made from a pig's stomach, introduced collapsed between membranes and uterine wall and filled with glycerine. It is more efficacious than a bougie, as with it the "latent period" is shorter.

Management of Labour and Care of the Infant.—As already stated, it is very desirable that the labour should terminate spontaneously. Whenever it is well under way the bougie or packing should be removed ; but it is a mistake to remove it too early, as uterine activity may completely quieten down.

The premature infant requires special care in the early days after birth. It should be kept uniformly warm, as it stands exposure badly. Generally speaking, it is better to have it wrapped up in gamgee for a week or ten days, for this can be easily removed and fresh gamgee substituted. Great care should be exercised in the handling of the child while bathing it and changing its clothing : on no account should it be lifted from its cot except when this is necessary (*vide* Care of Infant, p. 667 *et seq.*).

Various forms of baby incubators have been devised—the latest is "The Electric Thermostatic Nurse" (Hearson & Co., London) (p. 681). Most modern maternity hospitals have incubators installed.

All inquiries go to prove that if the premature child receives special care *in the first year* it grows up quite as strong as a child delivered at full term.

INDUCTION OF ABORTION

By induction of abortion is meant the emptying of the uterus before the child is viable. It is an operation which is only performed for some grave disease threatening the mother's life or subsequent health, and must never be lightly undertaken. Such diseases have been referred to already in connection with the diseases of pregnancy.

Amongst the conditions which may justify induction of abortion are : (a) intractable hyperemesis gravidarum ; (b) chorea ; (c) chronic nephritis, intractable albuminuria, and persisting high blood-pressure ; (d) cardiac disease with failing compensation ; (e) certain anæmias ; (f) phthisis pulmonaris (recrudescence) ; (g) insanity.

It must be made a rule never to perform the operation without having a consultation with one or more medical confrères. But while all medical practitioners are loath to perform the operation, this disinclination must not be carried to an extreme, for if the operation is postponed too long the patient may become so reduced in health that her life cannot be saved even by emptying the uterus. It is apparent, therefore, that the time for interfering and inducing abortion is often difficult to decide and can only be arrived at by carefully watching the patient from day to day and estimating how far she is resisting the disease, and to what extent she is responding to the prescribed treatment.

From the middle of pregnancy until the twenty-eighth week the operation should be carried out in a similar manner to that recommended for induction of premature labour, as labour at this period resembles very closely an ordinary parturition. When, however, it is a matter of inducing abortion in the earlier weeks of pregnancy different procedures must be adopted.

Before considering the operation we would remark that it is by no means a simple or easy one to perform, especially after the eighth week of pregnancy. Nor is it free from risk ; *indeed, it is a much more dangerous operation than induction of labour.*

There are several recognised methods for emptying the uterus in the early months of pregnancy. The most important are : (1) rupturing the membranes ; (2) dilating the cervix and plugging it with gauze ; (3) dilating the cervix with laminaria tents ; (4) vaginal or abdominal hysterotomy. It need hardly be stated that prior to the employment of any of these methods the patient should be prepared for the operation with the greatest care, so that the possibility of infection is minimal.

1. RUPTURING THE MEMBRANES.—This method is seldom suitable, as there is no certainty as to when the uterus will expel its contents.

2. DILATING THE CERVIX AND PLUGGING IT WITH GAUZE.—This method is seldom effective in inducing abortion. It is often found

necessary to repeat the plugging, and this adds considerably to the risks of infection.

3. DILATING THE CERVIX WITH LAMINARIA TENTS.—This we believe to be the safest method of inducing abortion provided there is no extreme urgency. The patient should be anæsthetised and the vagina disinfected. The cervix is then grasped by volsella, the vaginal walls being retracted if necessary. Before inserting the tent or tents the cervix should be dilated by metal dilators, ensuring that the point of the dilator has passed beyond the internal os. Too great force must not be employed nor too large a dilator used, as the soft cervix tears readily. One or more tents are then passed into the cervix. In doing this care must be taken that the tent is not pushed in too far, for if this occurs it will expand inside the uterine cavity, effect little dilatation of the cervix, and be very difficult to remove. In order to prevent this accident gauze should be inserted through the loop of linen thread attached to the tent (Fig. 299); this anchors it.



By courtesy of Allen & Hanburys Ltd.

FIG. 299.—Laminaria Tent. These tents are put up in sealed glass tubes ready for use.

while the rest of the gauze inserted in the vagina stimulates uterine activity. The tents should be removed in twenty-four hours, when it will generally be found that the cervix is considerably dilated and softened.

The disadvantage of this operation is that it necessitates at least two anæsthesias within a very short interval: but if "gas and oxygen" is employed there is no great risk unless the patient is gravely ill and emptying the uterus is urgent.

4. VAGINAL OR ABDOMINAL HYSTEROTOMY.—For rapid emptying of the uterus when this is urgent there is no method so good as the purely surgical one of either vaginal or abdominal hysterotomy. Until recently the vaginal route was the one generally employed. Many operators, however, prefer the abdominal route and empty the uterus as in ordinary Cæsarean section—a procedure specially applicable to cases in which it is deemed advisable to render the patient sterile by excising the Fallopian tubes—*e.g.* cardiac disease with very marked failure of compensation or pronounced chronic renal cirrhosis.

Where it is merely a question of emptying the uterus and sterilisation is not contemplated, the vaginal route is on the whole the better in the early months; but later (from the sixteenth week onwards) the abdominal route is to be preferred.

Vaginal Hysterotomy.—The ease or difficulty in performing the operation of vaginal hysterotomy depends largely upon the age of the

pregnancy. In the first half of pregnancy the uterus can be pulled down, incised, and the uterine contents removed comparatively easily.

The patient is placed in the lithotomy position and the vulva and vagina thoroughly cleansed. With a retractor the assistant pulls back the posterior vaginal wall (Fig. 300). The cervix is then grasped laterally by two volsellæ, which may be replaced by two ligatures, as the latter take up less room—by traction on them the cervix is pulled down. A transverse incision through the mucous membrane is made across the cervix below the reflection of the bladder; it should embrace the anterior half of the cervix. It is well also to make a vertical

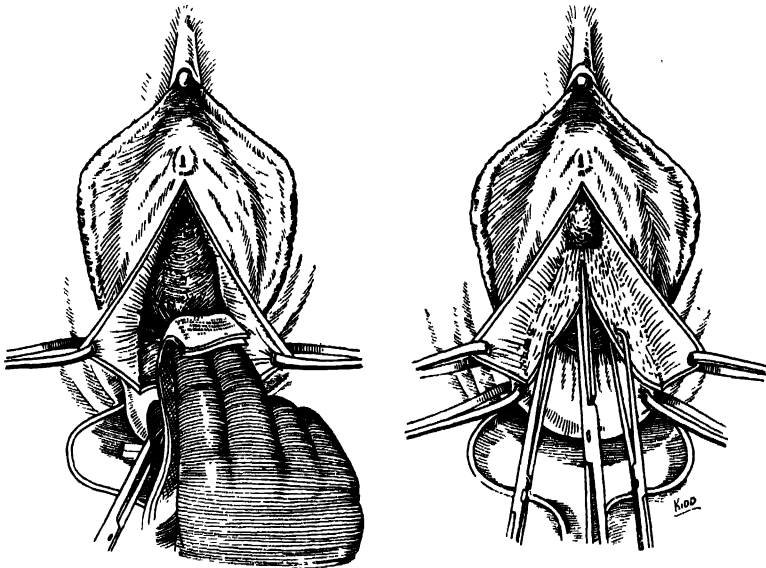


FIG. 300.—Vaginal Hysterotomy in the Early Weeks of Pregnancy. The left-hand figure shows the anterior vaginal wall separated from bladder and the operator pushing up the bladder with his fingers, this is best done with gauze. In right-hand figure he is dividing the cervix with scissors. Just above the point of the scissors is seen the lower part of the pushed-up bladder.

incision and separate the anterior vaginal wall from the bladder, as is done in operating upon a cystocele (Chapter LV). The bladder is then pushed off the cervix with the fingers, both in the middle line and at the sides; this is a most important step, as otherwise the bladder may be injured when making the incision in the cervix. The anterior cervical wall, now bare, is split up the middle line by means of scissors to the extent of permitting two fingers being introduced easily into the uterus. The membranes are ruptured and the foetus grasped by a foot and extracted. Even with a foetus of only twenty weeks there may be a little difficulty with the after-coming head; if so, the head is perforated with a pair of sharp-pointed scissors.

The membranes and placenta are then removed, 1 c.c. of pituitary extract administered, and an intrauterine douche at a temperature

of 116° F. is given to stimulate the uterus to retract. If retraction is not satisfactory the uterus should be packed firmly with gauze. The uterine wound is then stitched, and this is best done with a continuous catgut suture (Fig. 301). The bladder is then pulled back and tacked into position and the edges of the incised vaginal mucous membrane stitched.

Where the operation is performed in the later weeks of pregnancy more extensive incisions of the cervix are necessary, and by reason of this it is designated *Vaginal Cæsarean Section*. We do not, however, consider it suitable in a work professedly written for students to describe this elaborate and rather dangerous operation. Besides, few

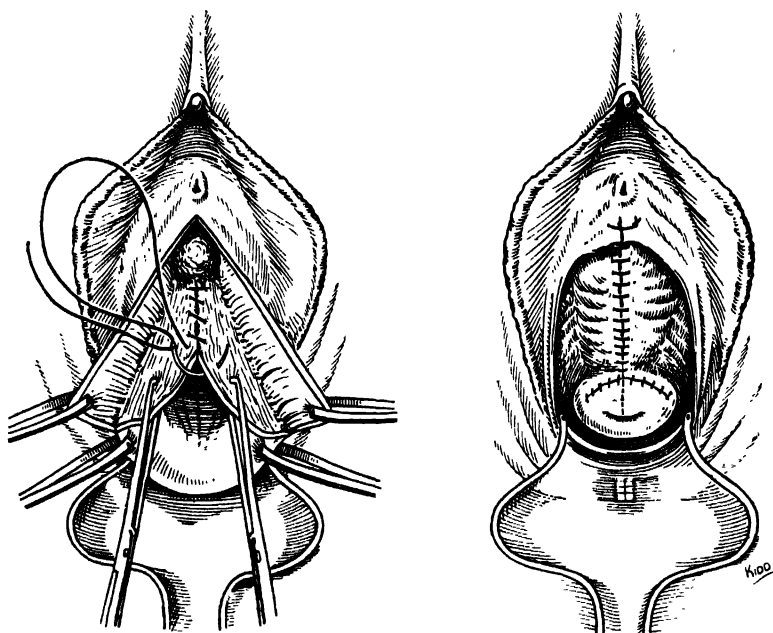


FIG. 301.—Continuous Suture being applied. Note in left-hand figure that the needle is passed from the cervical canal so that overlap of wound edges will be towards cervical canal. The right-hand figure shows the operation completed—bladder replaced and vaginal wound stitched.

obstetric specialists look upon it with any favour—they prefer abdominal Cæsarean section.

Abdominal Hysterotomy.—In recent years this method of evacuating the uterus has come into favour: It is the ideal operation even in the early months if sterilisation of the patient is considered advisable—e.g. in chronic nephritis, cardiac insufficiency, certain cases of tuberculosis, etc. The writer (J. M. M. K.) personally prefers the vaginal route when sterilisation of the patient is not indicated.

The operation is very simple. After the abdomen has been opened a small incision is made over the anterior wall of the uterus, and the contents detached with a finger and removed. The uterine wound must be very carefully stitched and completely covered with peri-

toneum (Lembert suture), so as to prevent any loop of bowel becoming adherent to uterine scar. Pituitrin (0·5 c.c.) should then be injected into the uterine muscle. Sterilisation is effected by excising a portion of the Fallopian tubes and burying the uterine ends under the peritoneum; or the uterine ends may be excised and the wound in the uterus stitched up.

ACCOUCHEMENT FORCÉ

Accouchement forcé, as the term implies, is the forcible dilatation of the cervix and extraction of the child—extraction of the child after the cervix is fully dilated, as in ordinary forceps or breech delivery, is not included under the term accouchement forcé. Only if the cervix is forcibly dilated and the child rapidly extracted is the delivery termed accouchement forcé. Never has the operation been looked upon with any favour by British obstetricians except in its simplest form, viz., manual dilatation of an intractably rigid cervix.

The outstanding condition for which the operation is suitable is the protracted labour caused by rigidity of the os externum if the condition

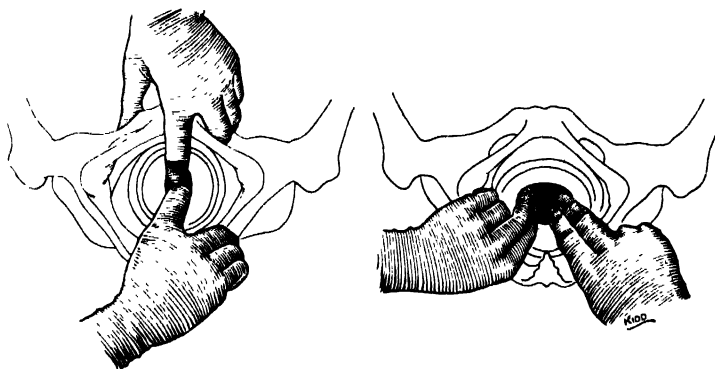


FIG. 302.—Bimanual Dilatation of Os Externum. Cervix must be completely taken up. Rarely is the operation commenced at this early stage.

of mother and/or child cause anxiety. It is contraindicated in placenta pravia and accidental hæmorrhage. It is seldom advisable to employ it as a means to hasten delivery in eclampsia or pre-eclampsia, although with the os externum fairly well dilated it may be justified in certain circumstances.

Great caution must be exercised in employing it, as shock may readily be induced from forcible dilatation. If the cervix is soft, complete dilatation of the cervix can be carried out without lacerating the cervix. It is obviously an operation that only the expert obstetric surgeon is justified in undertaking, and he rarely employs it.

METHODS OF DILATING THE CERVIX.—This may be carried out with the hands, rubber bags, expanding metal dilators, or by incisions.

Manual Dilatation.—There is shown here (Fig. 302) the best method

of dilating the cervix with the fingers ; it is a bimanual method. Very rarely does the operator commence dilatation at such an early stage of labour as here illustrated.

The patient is prepared in the usual way and brought to the edge of the bed in the lithotomy position. The operator, with hands gloved, passes a forefinger into the cervix, then a second finger, and then turning the backs of his hands together he slowly stretches the cervix, exerting pressure sometimes laterally, sometimes antero-posteriorly. Occasionally it is a little difficult to reach the cervix ; but if the assistant presses the fundus downwards the operator can generally introduce his fingers and employ them in the manner described—he should vary the direction of his pressure from time to time as shown in the illustration.

It is an excellent procedure when conditions are favourable ;

but it takes some little time, especially in a primipara. If hurried, severe laceration of the cervix will result. After dilatation is completed the child can be readily extracted if the vagina is well stretched and “ ironed out ” (p. 693).

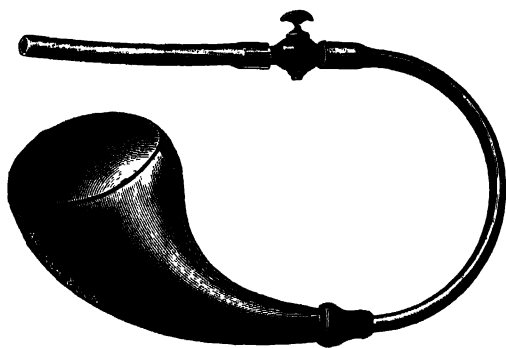


FIG. 303.—Champetier de Ribes Bag (large size and fully distended). Shown in position on p. 583.

Dilatation with Hydrostatic Dilators or Metreurynter.—The most common

types of hydrostatic dilator now employed are those designed by Champetier de Ribes (Fig. 303) and Voorhees. They should only be employed after rupture of the membranes, for if

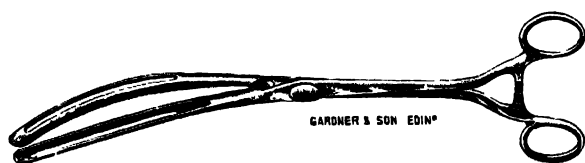


FIG. 304.—Forceps for introducing collapsed Champetier de Ribes Bag.

inserted with intact membranes the intra-uterine pressure is so greatly increased that the cervix and lower uterine segment may be ruptured.

Hydrostatic dilators are used very little in this country, but in other countries they are extensively employed.

The patient being anæsthetised is placed in the lithotomy position. Thereafter the field of operation is thoroughly prepared. Following this the operator grasps the cervix with volsella, and if the membranes have not already ruptured, perforates them with scissors or some pointed instrument. Having grasped the empty bag (the capacity and integrity of which have been previously tested or ascertained) with

the special forceps for the purpose, or an ordinary long pair of clamp forceps, the bag is carried up through the cervix into the uterus. The forceps is then withdrawn and the bag slowly filled with sterile water. The tubing is then wrapped up in gauze. If it is deemed necessary to hasten still further the dilatation, traction on the bag may be exerted through a cord attached to the tubing. This cord is brought over the foot of the bed and to it is attached a weight. The weight employed should not be more than a couple of pounds. The appearance of this bag in position has already been figured (p. 583). When the full bag is expelled the cervix is sufficiently dilated (4 in. \times 4 in.) to permit of the immediate extraction of the child, should that be deemed advisable, and this is generally the case.

Expanding Metal Dilators.—There is shown in the accompanying illustration (Fig. 305) a type of dilator very much favoured in the early years of this century. It and instruments of a like nature have fallen into disuse because of the danger of lacerating the cervix ; even

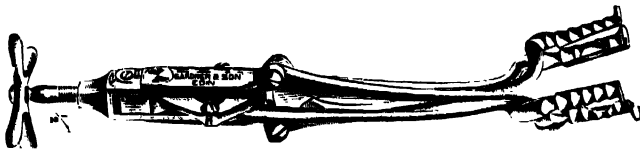


FIG. 305.—Bossi's Dilator.

when the greatest care is taken and the cervix very slowly stretched it is difficult to avoid doing serious injury. *There is no place for this type of instrument— we mention it merely because at different times in the past instruments of this type have been employed, and may be reintroduced in the future.*

Enlarging the Cervical Canal by Incisions when Cervix is taken up.—When the cervix is completely taken up, and it is only a question of dilatation of the os externum, two incisions, which in the compass would correspond to S.W. and S.E., are made with scissors. This brings about an enlargement of the cervical canal and a comparatively simple extraction if the child is small. Where the child is large, however, there is the danger that in rapid extraction the incisions may extend into the lower uterine segment. The incisions are sutured with interrupted catgut sutures. Employed by the experienced obstetric surgeon, the operation may be of great value in certain well selected cases.

The above operation is quite distinct from Vaginal Cæsarean Section already referred to (p. 740). In the former the cervix is completely taken up ; in the latter it is undilated. Consequently the former is a comparatively simple procedure, while the latter is a very difficult operation.

EMBRYOTOMY OR EMBRYULCIA

The operations under this heading involve destruction of the child and diminution of its bulk so that it may be more readily extracted. Their scope has receded in recent years as Cæsarean section has been extended.

CRANIOTOMY

The operation of craniotomy is of great antiquity. Until recent years it was a most laborious proceeding, for the instruments employed for the extraction of the head were imperfect. We have now, however, an excellent instrument for this purpose in the three-bladed cranioclast (Fig. 309), so that the operation has been very much simplified.

Indications.—Theoretically, craniotomy should only be employed if the child is dead, but it is justifiable on a living child under the following conditions: (a) when the child is hydrocephalic or suffers from some other gross malformation; (b) in contracted pelvis when attempts to deliver with forceps have failed; (c) in contracted pelvis when the parturient canal is gravely infected. There can be no difference of opinion regarding the first; but regarding the other two conditions there is not the same uniformity of opinion, for some employ Cæsarean section if the child is alive even under these unfavourable circumstances. We are opposed to the general employment of Cæsarean section in cases of "failed forceps." Undoubtedly with the lower segment operation greater risks can be taken; but even if this technique is employed the maternal mortality may be considerable. We advise, therefore, great discretion in employing Cæsarean section in such cases. Furthermore, as the foetal mortality (immediate and late) is so high (25 to 30 per cent.), it is quixotic to stress unduly "the interests of the child" (p. 731).

Craniotomy on a dead child has its limitations also. Most writers consider a C.V. of $2\frac{1}{2}$ inches (6.25 cm.) as the lowest limit. Even at this figure it may be very difficult if the child is large. In extreme deformities, therefore, there is no option but Cæsarean section even if the child is dead.

Operation—ON FORE-COMING HEAD.—The patient is prepared in the usual manner and anæsthetised, brought to the edge of the table and placed in the lithotomy position. The vulva, vagina and cervix should now receive a very complete disinfection, as so many of the cases on which this operation has to be performed are infected prior to admission to hospital.

The first step in the operation is perforation. The perforators employed in this country are Oldham's (Fig. 306) and Simpson's (Fig. 307).

The head of the child is steadied by an assistant grasping it from above the symphysis pubis. The perforator is held in the right hand



FIG. 306.—Oldham's Perforator—approximating the handles separates the cutting blades.

and passed into the vagina and through the dilated cervix, protected by two fingers of the left hand. The point of the instrument is then

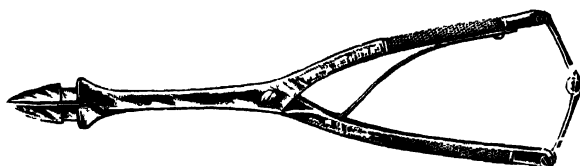


FIG. 307.—Simpson's Perforator. Here, too, approximating the handles separates cutting blades. Cutting blades are shown slightly separated and handles slightly approximated with crossbar bent. When cutting blades are closely approximated the crossbar is straight and locks the blades.

pushed through the skull (Fig. 308). In pushing or boring the instrument through the skull the direction should be at right angles to the surface of the head, otherwise there is danger of the point of the instrument slipping off the skull and injuring the soft parts of the mother. This accident is specially liable to occur if the point of the instrument is blunt.

It is of no great consequence if one perforates through a bone, suture, or fontanelle, but it is of distinct advantage *to make the hole in the skull as near the anterior fontanelle as possible*, for, as we shall see later when referring to the application of the cephalotribe, the blades of this instrument obtain a better grasp of the head if the opening in the skull is well forward. Having passed the perforator through the skull as far as the shoulders of the instrument, the handles should be approximated—this separates the cutting part of the blades and a large tear in the skull results. The instrument should then be turned round and a similar tear made at right angles, so as to make a wide opening in the skull. The next step is to pass the closed blades into the skull, and break up the brain-matter, especially in the region of the base of the skull. The instrument

should now be withdrawn under protection of the left hand, which has been directing the instrument in the vagina. It is unnecessary to douche out the broken-up brain.

The *extraction of the child* has been very much simplified since the introduction of the three-pronged instrument shown in the illustration (Fig. 309). This instrument is a modification of various bone forceps, cranioclats, cephalotribes and basillists devised by obstetricians of the past. It consists of three blades, one of which is placed within the skull, through the opening made by the perforator, whilst the other two are applied externally, preferably one over the face and the other over the occiput (Fig. 310). These external blades are brought together by a butterfly screw, and when approximated and the head crushed are kept in their place by two hinged shoulder bars, shown in the illustration, which are pulled down into position and serve as a means to exert traction. The instrument is straight; it has no pelvic curve.

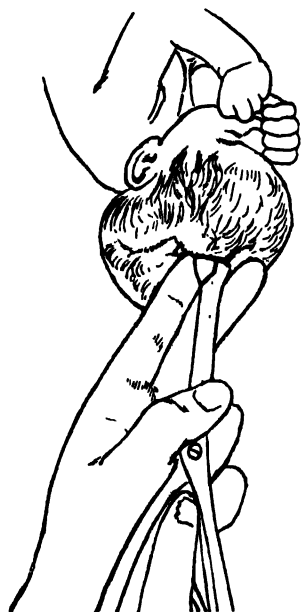


FIG. 308.—Perforation of Head.

It is employed as follows. The head is steadied from above by an assistant. The middle blade is inserted through the opening in the skull and the point passed up to the base of the skull, and then firmly screwed into the foramen magnum. There is no difficulty in getting

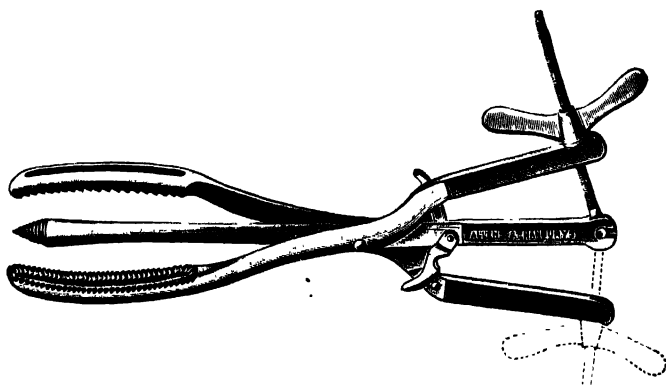


FIG. 309.—Combined Cranioclast and Cephalotribe (Jardine). This modification of Avvard's original instrument is a larger and better instrument. Note that the middle blade has a screw point which is screwed into the foramen magnum.

it into the foramen magnum, for by moving the point about at the base of the skull one readily appreciates when the point passes

into this opening. Having screwed the point of the instrument well into the base of the skull one of the external blades is now applied. *It will be found best to apply the first external blade over the surface of the face, for if the occiput is grasped first, flexion of the head is produced, and it is more difficult to get the second blade over the face.* The first blade is placed in position by carrying it upwards, under protection of the left hand, to the side of the promontory and rotating it into position over the face. The blade is now locked to the middle blade, the screw tightened (Fig. 310) and the front part of the head crushed. One can always tell at this stage that a good grasp of the head has been obtained with the blades if there is considerable resistance to approximating the outer and middle blades. The hinged shoulder bars is now pulled down and keeps the two blades fixed. The second external blade is now introduced and rotated over the occiput on the opposite side of the pelvis. In doing this it is sometimes easier to rotate the blade into its proper position over the occiput, *but at other times it is better to place this third blade to the side of the pelvis and rotate the occiput on to it with the other two blades already fixed.* The third blade is now locked, the screw applied and the head again crushed. If this ideal grasp with one blade over the face and the other over the occiput is obtained the instrument will never slip; but if the head is grasped obliquely, or if only one side of it is crushed, the instrument often slips during the process of extraction.

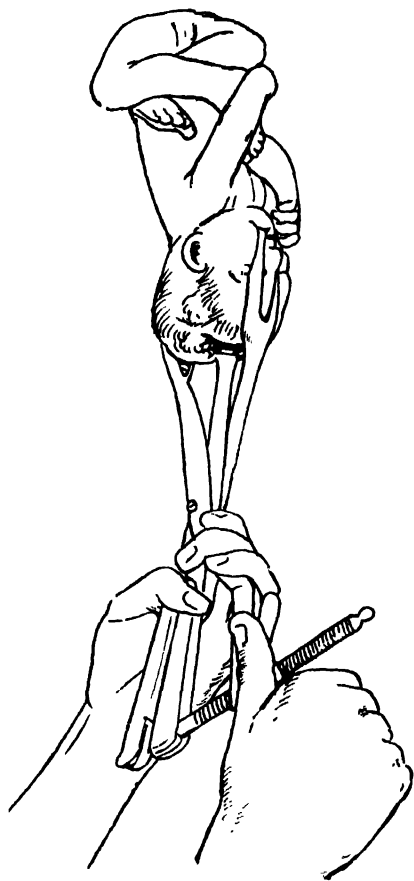


FIG. 310.—Three-bladed Cranioclast in Ideal Position. The right hand of operator is tightening butterfly screw of blade placed over the occiput.

The instrument having been applied as described, the operator proceeds to extract the crushed head. In doing this the instrument should be encouraged to rotate into the smallest diameter, which in flat pelvis is the antero-posterior diameter. Traction should be made downwards and backwards in the first instance and

then the head should be delivered in the ordinary manner, care being taken to avoid laceration of the perineum.

Unless the deformity is extreme the force necessary to effect the delivery is comparatively slight. The chances of the blades slipping if a good grasp has been secured, even when considerable traction is employed, are not great, but it is advisable that the operator should always keep the fingers of his left hand against the head and make sure that the head is actually descending while he is pulling. With the modern instrument there is little risk of laceration of the soft parts from splinters of bone, for the broken-up bones are protected by the scalp.

Having extracted the head the trunk is removed without difficulty, provided the shoulder girdle is not large. Should difficulty occur with the shoulders the clavicles should be divided (Cleidotomy, p. 751).

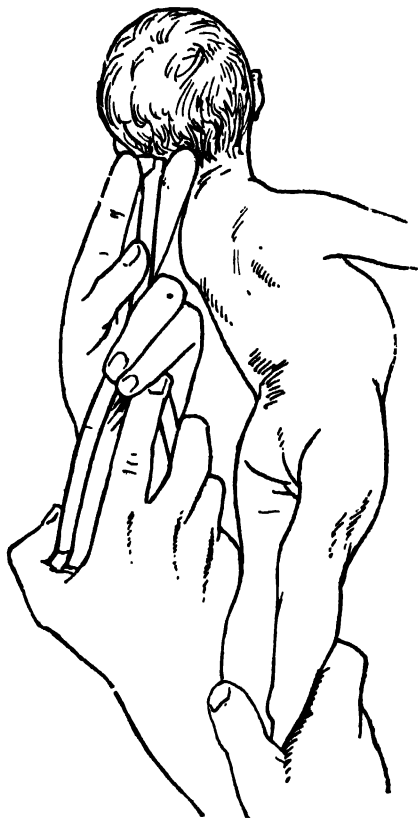


FIG. 311.—Perforation of After-coming Head.

CRANIOTOMY ON THE AFTER-COMING HEAD.—In many respects this is a simpler operation than the one on the fore-coming head just described. The operation is performed as follows (Fig. 311). The arms of the child having been brought down, the assistant grasps the feet and directs traction upwards towards the symphysis pubis, so as to bring the base of the skull within easier reach of the operator. The perforator, under protection of two fingers of the left hand, is carried along

the dorsal aspect of the child's trunk up to the base of the skull. It is then pushed through the skull in the neighbourhood of the *postero-lateral fontanelle just behind the ear*. An opening is made in the manner already described in perforation of fore-coming head. The brain-matter is then broken up and extraction proceeded with.

In practically all cases it will be found possible to extract the child with the old-fashioned crotchet (Fig. 312) passed through the opening made with the perforator, but to secure a firm grip the point of the instrument must be turned towards the vertebral column. With this instrument a very firm hold of the skull can be obtained,

because the bones at the base of the skull are so strong. *It is impossible to apply the three-pronged instrument in this operation.* Suprapubic pressure should not be employed to assist extraction of the head, as the soft parts may be seriously bruised.

Another site for perforation of the after-coming head is through the hard palate. It is not so good a site, however (*except in the case of an impacted mento-posterior face presentation*), for one cannot obtain so firm a grasp of the base of the skull with the crotchet.

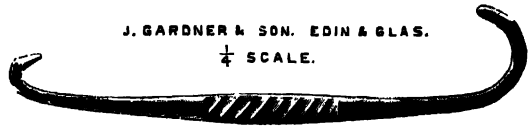


FIG. 312.—Crotchet and Blunt Hook (combined).

DECAPITATION

The operation of decapitation consists in severing the head from the trunk, followed by extraction of the trunk and then of the detached head.

The indication for the operation is an impacted shoulder presentation (p. 479), where the uterus is so firmly retracted over

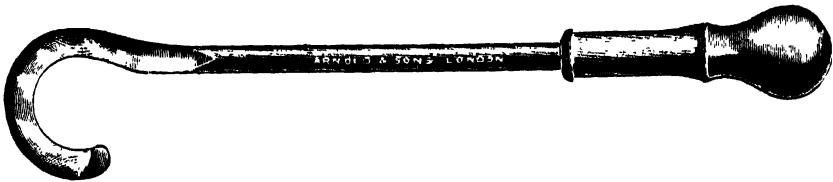


FIG. 313.—Decapitating Hook (Ramsbotham's).

the child that version is a dangerous procedure. Various instruments have been suggested, such as hooks, knives, scissors, wire-saws, etc., but the most useful instrument is one of the decapitating knives shown in the illustrations (Figs. 313. 314).

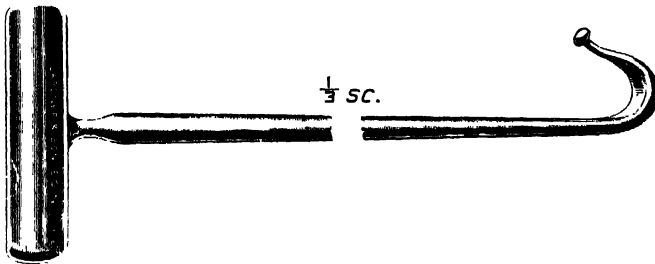


FIG. 314.—Decapitating Hook (Jardine's).

OPERATION.—The patient is prepared in the ordinary way and anæsthetised. She is then brought to the edge of the bed, placed in the lithotomy position, and a final disinfection of the vagina and vulva carried out.

It will be observed in the illustration (Fig. 315) that one arm

of the child has prolapsed and to it a loop of gauze has been attached. This is of great advantage, as it brings the neck of the child within more easy reach, steadies the trunk and facilitates the carrying of the decapitating knife over the child's neck. Indeed, it is of such advantage that we recommend the operator to bring down an arm, if one has not prolapsed, provided he can do it easily.

The exact position of the neck having been determined, the decapitating knife, protected by the fingers of the left hand, is passed up over the child's shoulder. The point is then turned over the neck. By backward and forward movements the neck is divided.

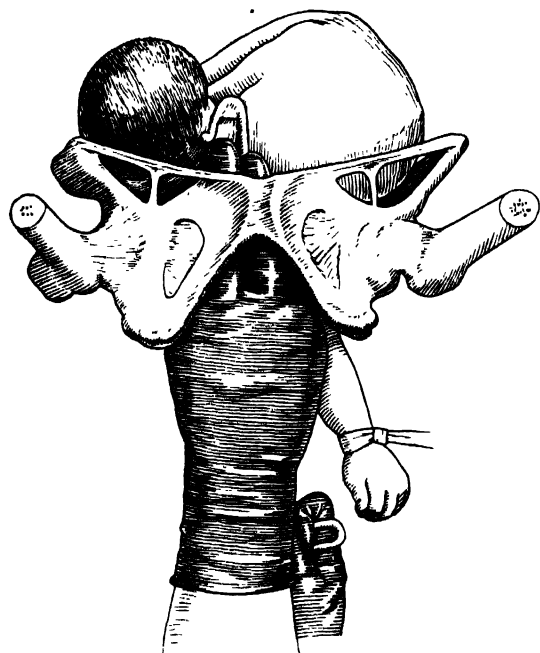


FIG. 315.—Decapitating Knife (Jardine's) is being passed round Neck of Fetus. Traction is made on arm—this brings neck within easier reach and fixes the head and trunk.

The extraction of the trunk is then a very simple matter, for by traction on the prolapsed arm the trunk can be readily dragged out of the pelvis. Occasionally, especially if there is considerable pelvic deformity, some little difficulty may be experienced with the after-coming head. Should this occur it is better to perforate the head and diminish its size rather than apply forceps and have to exert a considerable amount of force in its delivery. To carry out craniotomy the head

must be fixed at the brim by suprapubic pressure by an assistant before perforation is performed.

There is one important detail connected with removal of the head. As the decapitation takes place close to the trunk most of the cervical vertebræ are attached to the head, consequently this can cause serious injury to the lower part of uterus and vagina if the head is not extracted carefully.

EVISCERATION

This operation consists in the removal of the abdominal or thoracic contents with the object of diminishing the bulk of the child. It is not nearly so suitable for impacted shoulder presentation as decapitation.

Its special application is in cases where there is any great distension of the child's abdomen by a tumour (p. 487). In such circumstances the operation is comparatively simple ; in respect to foetal ascites perforation of the child's abdomen is all that is necessary.

A large opening is made with the perforator or scissors through the abdominal or thoracic wall ; the viscera are then broken up with the fingers and removed. Generally speaking, it is no great advantage to remove the thoracic content, for the lungs and heart are very small.

The extraction of the trunk is generally not difficult with a head

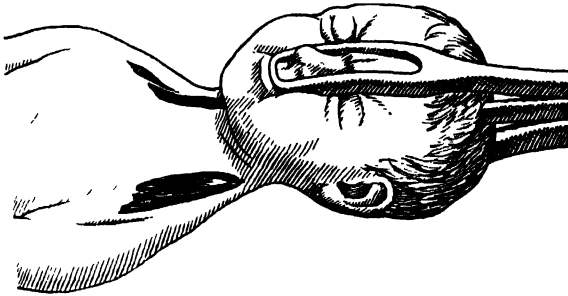


FIG. 316.—Showing the collapsed shoulder girdle after Cleidotomy.

or breech presentation, which are almost invariably the presentations in abdominal distensions of foetus.

Very occasionally the operation has to be performed for impacted transverse presentation, in which it is impossible to reach the shoulder. In this event the vertebral column should be divided (termed "spondylotomy") by either scissors or a knife. In such cases some difficulty may be experienced in the extraction of the upper half. It will be found best to deliver the lower half first by traction on the legs, and then bring down the remaining half of the trunk, disengage the arms, and last of all perforate the after-coming head. Obviously this complicated operation may be extremely difficult.

CLEIDOTOMY

The operation of *cleidotomy*, or division of the clavicles, has for its object the reduction of the circumference of the shoulder-girdle. It is generally performed in association with craniotomy, when, after extraction of the head, it is found impossible to bring down the shoulders (Fig. 316).

The clavicles are divided with scissors or a knife passed up under protection of the fingers of the left hand and along the ventral aspect of the child until the clavicles are reached. The bone is divided on each side, with the result that the shoulder-girdle collapses and the trunk can be readily extracted.

PART IX
MATERNAL MORTALITY, MORBIDITY
AND DISABLEMENT

TABLE I.—DISEASES OF PREGNANCY, LABOUR AND THE PUERPERAL STATE (INTERNATIONAL CLASSIFICATION)

The percentages have been added by the writer so that the reader may appreciate at a glance the toll each condition takes

Years.	England and Wales.			
	1935.	Per Cent.	1937.	Per Cent.
140. Abortion with septic conditions	262	10·6	173	8·7
141. Abortion without mention of septic conditions	91	3·7	50	2·5
142. Ectopic gestation	74	3·0	75	3·7
143. Other accidents of pregnancy (not including hæmorrhage)	16	1·1	21	1·0
144. Puerperal hæmorrhage—				
(a) Placenta prævia	253	10·3	296	14·8
(b) Other hæmorrhages				
145. Sepsis and puerperal infections (not specified as following abortion)	744	30·2	423	21·2
146. Puerperal albuminuria and convulsions	348	14·2	333	16·7
147. Other forms of toxæmia of pregnancy	138	5·6	167	8·4
148. Phlegmasia alba dolens, embolus or sudden death (not specified as septic)—	165	6·7	139	6·9
(a) Phlegmasia alba dolens and thrombosis				
(b) Embolus or sudden death				
149. Other accidents of childbirth	311	12·2	262	13·1
150. Other, or unspecified, conditions of the puerperal state	55	2·2	49	2·5
Total deaths (including abortion other than criminal)	2457	100	1988	100

List Nos. 140, 141, 142, 145 and 146 are self-explanatory.

List No. 143 is a very small group and includes hydatidiform mole, hydramnios and other odd conditions.

	1935.	1937.
List No. 144 includes :		
Placenta prævia	123	133
Accidental hæmorrhage	11	16
Postpartum hæmorrhage	65	80
Adherent or retained placenta	54	67
Total	253	296
List No. 147 includes :		
Toxæmia of pregnancy	97	111
Uncontrollable vomiting	35	52
Chorea of pregnancy	6	1
Total	138	164
List No. 148 includes :		
Phlegmasia alba dolens not returned as septic	43	53
Puerperal embolism and sudden death *	122	86
Total	165	139

* (N.B.—This return has never been considered satisfactory. It is impossible that there are as many deaths from this cause as from placenta prævia shown in List No. 144.)

List No. 149: This includes all the deaths associated with delivery—contracted pelvis, malpresentations, rupture of uterus, etc.

List No. 150: This small group includes a number of conditions such as puerperal insanity, diseases of breasts, etc. Most of them should be included under other list numbers.

The accepted method of presenting mortality of Pregnancy, Childbirth, and the Puerperal State is to divide deaths into those due to *Sepsis* and those due to *Other Causes*; and to present the ratios in terms of 1000 *live-births*, or *live- and still-births*, but generally the former.¹ The table following gives the Decennial Means, 1855-1924, and the Quinquennial Mean, 1931-35, for England and Wales and for Scotland. From these figures it will be noticed that approximately two-fifths of the deaths are due to *sepsis* and three-fifths to *other causes*.

TABLE II.—DECENNIAL MEANS, 1855-1924, AND QUINQUENNIAL MEAN, 1931-35: DEATHS FROM PUERPERAL CAUSES IN ENGLAND AND WALES AND IN SCOTLAND

Years.	Mean Annual Deaths.		Metria or Puerperal Fever.		Other Diseases and Accidents of Childbirth.		Death-rate per 1000 Live Births.					
							Total.		Puerperal Fever.		Other Diseases.	
	E.	S.	E.	S.	E.	S.	E.	S.	E.	S.	E.	S.
1855-64	3213	512	1074	180	2139	332	4.7	4.9	1.6	1.7	3.1	3.2
1865-74	3935	595	1517	213	2418	382	5.0	5.1	1.9	1.8	3.1	3.3
1875-84	4038	660	2044	252	1994	408	4.6	5.2	2.3	2.0	2.3	3.2
1885-94	4519	658	2345	306	2173	353	5.1	5.3	2.6	2.5	2.4	2.8
1895-04	4200	605	1901	246	2289	359	4.6	4.6	2.1	1.9	2.5	2.7
1905-14	3438	703	1417	216	2021	488	3.9	5.6	1.6	1.7	2.2	3.9
1915-24	2987	697	1151	196	1836	502	3.9	6.2	1.5	1.7	2.4	4.5
1931-35	2602	548	1064	226	1538	322	4.3	6.1	1.8	2.5	2.5	3.6

E. England and Wales. S. Scotland.

The figures presented in above table are the deaths and death-rates due *directly* to Pregnancy, Labour, and the Puerperal state. They do not include, however, "Deaths of Women not classed to Pregnancy and (childbearing but returned as Associated Therewith"—these deaths are included in a special table in the *Statistical Review* ("Text Volume") of the Registrar-General of England and Wales and, in recent years, in the *Annual Report* of the Registrar-General for Scotland. They are compiled from the death certificates in which pregnancy and/or childbirth is mentioned.

From above table it would appear that the death-rate for Scotland is very much higher than for England and Wales. In point of fact, this is not the case. Although most countries adopt the International Classification, in the main, the allocation of deaths to those *directly* due to Pregnancy, Childbirth and the Puerperal state, and those *associated therewith*, varies greatly. This renders comparisons between the death-rates of different countries impossible at the present time. Even between England and Scotland many adjustments have to be made before a comparison is justified. In point of fact, there is little difference in the maternal death-rates of the two countries (*vide* "Report on Maternal Morbidity and Mortality in Scotland," 1935, p. 6).

¹ If still-births are included 0.23 per 1000 has to be deducted from the ratios given.

Many of the injuries, the result of parturition, are difficult to repair, although most of them can be corrected by operation. Reference is made in the next chapter to some of the commoner injuries for which parturition is responsible.

There is much writing and talk about maternal mortality, but when morbidity has been fully investigated it will be found that on a conservative estimate somewhere *between 7 to 10 per cent. of women suffer less or more disability as a result of pregnancy or childbirth.* It must therefore be the constant endeavour of all who attend women in pregnancy and childbirth not only to ensure for such women safe conduct through pregnancy and labour, but to see to it that they suffer as little disability as possible therefrom.

PART X
GYNÆCOLOGY



FIG. 317.—CANCER OF VAGINAL CERVIX.

Proliferative (cauliflower) type. History:—age, 48; children, eleven; abortions, three. Last confinement eight years ago. Complained of irregular bleeding. The specimen is an old one in the museum of the Royal Samaritan Hospital, Glasgow, and there is no record as to how it was obtained. It is an excellent example of its type. An encircling band of vaginal-cervix mucosa is present. The tumour is growing from the posterior lip. The external os is therefore towards the reader. (The early stage of this is represented diagrammatically in Fig. 379, 1.)

CHAPTER XLII

CONNECTING CHAPTER BETWEEN OBSTETRICS AND GYNÆCOLOGY

THE purpose of this short chapter is to act as a link between the obstetrical and gynæcological halves of this manual. A link implies a gap between the things which it unites, but in this case the gap is more nominal than real. In systematic teaching and in the great majority of textbooks the two subjects are treated separately—in the former for reasons of simplicity, in the latter for reasons of convenience in regard to size. In both out of conformity to traditional usage. A very brief experience of clinical teaching or of clinical practice, however, serves to dispel the idea of there being any real gap, and there are other considerations which confirm the view of the essential unity of the two subjects, which may indeed be said to be but different aspects of one.

The first of these considerations derives from a philosophic view of the functions of the female reproductive organs. Teleologically, their function is the reproduction of the species, but reproduction, while essential to the continuance of the race, is not essential to the life of the individual man or woman. In the conditions of civilised human life there are many individuals who, although physiologically normal, never fulfil the function of reproduction, either because they never have sexual intercourse or because such intercourse is unfruitful. In such women (for we need not here consider the male) the subsidiary functions of the reproductive organs may occur quite normally, for example, the changes concerned in the menstrual cycle, and, it may be, those concerned in sexual intercourse.

Although the majority of women accept the situation and adjust themselves to disappointment of motherhood—the unmarried, in addition, to abstention from intercourse—there are some in whom these deprivations, at variance with the intentions of Nature, exercise subtle influences on their physical and mental wellbeing. It is the height of foolishness to magnify these influences unduly; but, on the other hand, it is well to bear them in mind when in such individuals minor disturbances occur, difficult to explain on ordinary lines.

The knowledge of the subsidiary functions of reproduction in their physiological, pathological, and psychological aspects is more the province of gynæcology than of obstetrics, which is concerned with the major functions of pregnancy and parturition. But these subsidiary

functions are the necessary precursors of reproduction, and in regard to them we have a large field of knowledge in which gynæcology and obstetrics are organically united.

Compared with this, the other considerations are relatively superficial, although none the less of vast practical importance. There is, for example, the fact that parturition, whilst in the vast majority of cases normal and physiological, is always liable to be associated with complications that result in conditions which are gynæcological. This is so well recognised that it has been epitomised in the aphorism that "good midwifery is preventive gynæcology." Every gynæcologist finds that a large proportion of his work consists of dealing with conditions of disease or injury following upon parturition, and a smaller part of it with conditions which prevent the desired occurrence of pregnancy, and the only point in doubt is as to the proportion of such work to the whole—whether, say, 50 or 60 per cent.

Again, it is the custom in most civilised countries for obstetrics and gynæcology to be linked together as a common subject of specialist practice, and this is not merely a matter of convenience. It is, fundamentally, the outcome of a recognition of the considerations already mentioned, and of the belief which, born of experience, is implicit in them, that to be a wise gynæcologist one must have a thorough knowledge of obstetrics and vice versa. The two subjects in practice are like the pianist's two hands, which produce the most perfect harmony when both are controlled by the single brain which stores the necessary knowledge and forms the judgment essential to the highest control of their movements.

It is not without interest to point out that not only are obstetrics and gynæcology thus united to each other, but that they afford what is generally regarded as the best example of the essential unity of medicine and surgery. "The obstetrician and gynæcologist is the great example of the unity of medicine and surgery in actual practice. Here is the full integration." Thus wrote Sir George Newman in 1918, and the great development of our physiological knowledge in regard to the female sex organs since that date has only served to increase the truth of his words.

Passing from these general considerations, it may be helpful to amplify what has been said by some rather more specific examples.

The preventive aspect of gynæcology obviously deserves priority in consideration. Much of this must always lie in the hands of the family practitioner. The antenatal care of the future mother begins in her infancy, in the prevention of rickets and in supervising the general hygiene of her childhood. As she approaches puberty, care has to be taken that overwork at school or over-indulgence in the more strenuous forms of exercise is not allowed to affect the normal development of the menstrual functions. Simple instruction in the elements of sex knowledge will help the girl to avoid the dangers of

a foolish disregard of the menstrual functions on the one hand, and of a morbid over-attention to them on the other, while it will also do much to endow her with a normal mental outlook on sex. Later on, when she contemplates matrimony, every girl should be told simply and briefly about the physical side of marriage, and, failing an intelligent and wise mother, this office can often be best undertaken by the family doctor. In this way many young married women may escape much of that fear of sexual relations which fosters an unnatural repugnance and tends to frigidity, vaginismus and sterility, while others may be protected from the risks of excess.

The manifold causes of sterility in women provide an example of the link between gynæcology and obstetrics, but need not be specified in detail here. It is sufficient to state that they include all structural and functional obstacles to proper intercourse, as well as disorders of menstruation and ovulation and disordered conditions of the tubes and uterus.

From the practical point of view, the sequelæ of parturition with which the gynæcologist has subsequently to deal form the most obvious and important link between the two subjects. It has been estimated by Blair Bell that, while some 3000 women die annually in England and Wales from conditions arising immediately out of childbirth, not less than 60,000 in each year become the subjects of a greater or less degree of disablement which affects their efficiency generally and particularly as mothers of families, and may indirectly shorten their lives. In many cases the disabling conditions so initiated or intensified by childbirth are of a medical rather than of a gynæcological nature and do not directly concern us here. Such, for example, are cardiac conditions, secondary anæmia, renal disease resulting from pregnancy toxæmia, or from pyelonephritis, and nervous disorders. Obviously these conditions cannot be wholly excluded from the consideration of the gynæcologist, because they are frequently associated with lesions which he is called upon to treat and may seriously complicate the issue.

The more purely gynæcological sequelæ are for the most part the outcome of puerperal infection and of trauma; frequently of both together, since infection is so often the result of trauma.

Nature's methods of combating infection and of repairing the results of inflammation frequently involve the formation of adhesions on the peritoneal surfaces of the pelvic organs, which subsequently contract and produce displacements and interference with function; or a degree of sclerosis of the tissues, which likewise interferes with normal function. So far as serious permanent damage is concerned, the Fallopian tubes suffer most, probably owing to lack of adequate drainage; and when the tubes are infected the ovaries rarely escape. Subacute or chronic salpingo-oöphoritis, with or without the formation of pyosalpinx or tubo-ovarian abscess, is one of the most serious

sequels of puerperal infection, not only because of the ill-health and suffering which it causes but because it either requires ultimate operative removal of the affected organs or is liable to leave the woman with tubes and ovaries which function imperfectly or not at all.

A much more common but less immediately serious result of infection at childbirth is cervicitis, which is usually combined with laceration of the cervix. The infected cervix is a focus from which infection may spread to the parametrium and to the other pelvic organs, producing a very varied train of chronic symptoms characterised by pain and discharge and producing much chronic ill-health. The reproductive function is usually affected in such women and either sterility or repeated abortions may ensue. But the most important possibility is the ultimate development of cancer of the cervix, which is pre-eminently the cancer of the parous woman and is generally believed to arise as a remote sequel to infected cervical lacerations.

The conditions known as chronic subinvolution and chronic metritis (fibrosis uteri) form another group of gynæcological complaints arising out of parturition. Their pathology is not fully understood, and whether they are the local outcome of chronic infection only or in part, at least, the reflection of the disordered influence of the sex hormones, remains to be proved. But whatever their exact pathology, their connection with parturition is clear and they must be included in the category of the conditions under consideration.

M'Intyre's investigations of over 7000 cases at the Royal Samaritan Hospital, Glasgow, show that trauma is an even more frequent cause of gynæcological sequelæ following labour than infection. In his series of cases 28 per cent. were traceable to infection, 35 per cent. to trauma, and 8 per cent. to both. Amongst 2730 traumatic cases, in which many patients presented more than one lesion, the incidence of the more frequent lesions was as follows :—

Perineal laceration	975 cases (complete in 116)
Cervical laceration	959 „
Backward displacement of the uterus	729 „
Uterine prolapse	476 „ (complete in 162)
Cystocele	433 „
Rectocele	332 „
Genital fistulæ	31 „
Urethral injury	15 „
Rupture of the uterus	2 „
Inversion of the uterus	2 „

M'Intyre's analysis reveals a point of great interest, namely, that in only about half the cases had instrumental interference been necessary during the precedent labours. In other words, the natural

forces of parturition can and do cause nearly half the damage. Complete laceration of the perineum was the injury most commonly (79 per cent.) associated with instrumental delivery, whilst complete prolapse was at the other extreme (37 per cent.). M'Intyre suggests that "bearing down" during the first stage of labour, so often encouraged by unwise nurses, may explain the occurrence of procidentia in women who have had numerous children but no instrumental labours (*vide* p. 403).

With regard to all the injuries mentioned, the prophylactic importance of good midwifery is obvious, although it must be freely admitted that even with the exercise of the greatest skill and care it may not be possible to avoid some degree of damage. But good obstetrics does not stop at prevention; it should include the immediate repair of injuries so far as conditions permit. In this way the incidence of infection can be diminished and much disability, ill-health and discomfort prevented. Especially does this apply to injuries of the perineum and cervix. But it should be emphasised that it is better to postpone repair operations for twelve to twenty-four hours and do them properly, with good antiseptic technique and adequate assistance, rather than to do them in an imperfect and possibly perfunctory way in the adverse conditions so often existent at the time of delivery in domiciliary practice.

Backward displacement of the uterus is another outstanding example of a condition commonly associated with gynæcological symptoms which is easily prevented by care in the puerperium. The mere position of the uterus is probably of little moment, but the conditions which favour its occurrence in the puerperium are prone to favour also subinvolution, etc. The examination of the puerperal patient in the third week after delivery and the correction of the displacement, if present, and the introduction of a pessary, to be worn for two or three months, enable the involution of the supporting structures to proceed with the uterus in its correct position, and thereafter there is little likelihood of the displacement recurring. The correction of the position of the uterus also favours its adequate drainage and prevents any interference with its circulation, and so tends to the spontaneous cure of any tendency to subinvolution.

Backache is a common gynæcological complaint and is often due to sacro-iliac or lumbo-sacral strain following pregnancy and labour. Here, also, much can be done in the way of the prevention of suffering and disablement by the prompt recognition of the condition by the obstetrician, and its treatment by heat, massage, exercises and a well-fitting belt. Pain over the symphysis pubis of a somewhat similar origin is much less common.

In connection with the all-important subject of cancer of the cervix, the late Professor Graves of Harvard quoted the following figures, which reveal the enormous preventive value of repair of

cervical lacerations and speak so clearly for themselves that no further comment is needed :—

Cancer of the Cervix in Parous Women

Number examined	488
Number in which repair of the cervix had been performed	9 ¹

After-history of Cases in which Cervical Repair had been Practised

Number examined	4815
Number in which cancer had developed subsequently	4 ²

Passing from the consideration of gynæcological sequelæ of parturition, we find that certain cases require the simultaneous exercise of both obstetrical and gynæcological knowledge. Fibroid and ovarian tumours, and even cancer of the cervix, may coexist with pregnancy, and such complications as torsion of the pedicle of an ovarian tumour, or acute degeneration of a fibroid, or hæmorrhage from the cancerous cervix may arise. The connection between chorionepithelioma and a precedent hydatidiform mole may also be mentioned.

The questions of differential diagnosis also provide common ground to obstetrics and gynæcology in many cases. The diagnosis of an early pregnancy is very easy when the history, symptoms and physical signs all tally, but when some considerable discrepancy or abnormality is present it may require both obstetrical and gynæcological skill and experience to settle the question. The coexistence of pregnancy and pelvic tumours and the disconcerting condition of pseudo-cyesis afford examples of such difficulty, while a more frequent and familiar one is the differentiation between tubal pregnancy and threatened uterine abortion. The modern rapid biological tests for pregnancy play an important and helpful rôle in many such cases, and X-rays are increasingly helpful as the pregnancy advances.

Lastly, mention may be made of the functional disorders of the endocrine glands concerned either directly or indirectly with reproduction which sometimes follow upon pregnancy. The nature of these functions has already been explained in so far as we know them at present, but the delicacy of their interrelationships cannot be overemphasised, nor the full extent of their far-reaching influences stated. How or why pregnancy and parturition sometimes upset their harmonious working is not clearly understood, but experience indicates that they may do so. The commonest example is probably

¹ Operations performed many years previously and probably with poor technique.

² In two of these four cases there was evidence that the operation had been badly performed.

the tendency for a woman to remain fatter after her confinement than she was before she became pregnant. The explanation probably lies in some imperfect functioning of the thyroid and/or the anterior pituitary lobe, but the connection between such imperfect function and the precedent pregnancy or labour is not clear. The existence of amenorrhœa during lactation may very possibly have an endocrine basis. But more important are the presumable disturbances of function which result in the irregular uterine bleedings of the *metropathia hæmorrhagica* type, including in some instances the condition of subinvolution of the uterus.

CHAPTER XLIII

DISORDERS OF FUNCTION

Disturbances in the Incidence of Menstruation — Amenorrhœa —
Anomalous Uterine Hæmorrhages — Leucorrhœa — Dysmenorrhœa —
Intermenstrual Pain — Dyspareunia — Sterility — Contraception

THE conditions described in this chapter are, in great part, merely the symptoms arising from definite organic lesions which will be dealt with in later chapters. It is necessary, however, to describe the types and associations of these symptoms.

DISTURBANCES IN THE INCIDENCE OF MENSTRUATION

Precocious Menstruation.—This term denotes the occurrence of a hæmorrhagic vaginal discharge before the normal age of puberty (p. 43). Such hæmorrhage may occur as a very transient phenomenon in newborn children when it is probably due to the influence of œstrogen derived from the mother while the fœtus was *in utero*. It may appear in association with some tumour of the uterus or ovaries, usually malignant, or simply as the precocious establishment of puberty even as early as the third year. These conditions are considered later among the forms of anomalous uterine hæmorrhages (p. 782).

Delayed Menstruation.—Puberty may not occur until the eighteenth or twentieth year, but the delay in the appearance of menstruation is not usually associated with delay in the appearance of the secondary sexual characteristics. The usual cause is an underdevelopment of the reproductive organs, though in some cases the organs may appear normal on examination, and the condition allow of no obvious explanation. Those patients frequently have an early menopause (p. 65).

Infrequent and Scanty Menstruation.—These conditions, which may or may not occur together, are usually associated with hypoplastic organs. The term *hypomenorrhœa* has been given to the type in which menstruation is infrequent; and *oligomenorrhœa* to that in which the menstrual cycle is unaltered but the duration and amount of discharge less than normal. The difficulty in standardising lesions in gynæcology may be seen from the fact that infrequent and scanty periods may be acquired by women under many dissimilar conditions: in those whose muscular and skeletal development is of the masculine type as in some women athletes, in those whose occupations require great mental

strain, or in those who lead a luxurious, inactive, overfed existence. The difficulty is further emphasised by the fact that some women with scanty and infrequent periods have normal reproductive organs and are quite fertile.

Vicarious Menstruation.—True vicarious menstruation occurs when the menstrual periods are replaced by the periodic discharge of blood from some other locality in the body, which may or may not be the seat of a pathological lesion—*e.g.* by hæmatemesis in patients suffering from gastric ulcer, by hæmoptysis in cases of pulmonary tuberculosis, or from the normal nasal mucous membrane. True vicarious menstruation is rare; very frequently the menstrual period is associated with an additional hæmorrhage from the sites just mentioned. Here is an interesting case of this type which came under our notice. In a young woman with extensive superficial burns, large hæmorrhagic bullæ appeared under the injured skin at the three successive menstrual periods while she remained under treatment for her burns. Generally the symptoms correspond to those of the molimen and no actual treatment is required unless the distant hæmorrhage becomes so great as to be a source of danger; in that event local treatment should be employed if this is feasible, and calcium therapy is said to be helpful in some cases.

Menopausal Irregularities.—A premature menopause may occur in women in whom puberty appeared very late. On the other hand, the persistence of the menstrual function beyond the fiftieth year may be due to some lesion of the reproductive organs, such as fibromyoma, and in certain ovarian conditions referred to later.

AMENORRHŒA

Absence of the menstrual function occurs as a physiological phenomenon during pregnancy and the early months of lactation, though not always in the latter case, and is, of course, the normal condition before and after the period of active reproductive life. In all other conditions amenorrhœa must be regarded as a pathological condition. It may be either *primary* or *secondary*—under the former heading will be included here a condition which is not a true amenorrhœa, but only concealed or pent-up menstrual discharge.

Primary Amenorrhœa—CONCEALED MENSTRUATION.—In this condition, which is also described as *cryptomenorrhœa*, the accumulation of the menstrual discharge goes on month by month. The process is slow, as there is considerable absorption of fluid during the intermenstrual intervals, and the retained secretion becomes concentrated to a thick tarry substance. In most cases the patient experiences all the sensations which usually accompany the menstrual epochs (p. 53): As the accumulation increases, she may have in addition increasing pelvic discomfort, with attacks of sickness. In a few cases the

molimen may never have been experienced. The patient comes under the doctor's notice because her mother is anxious about the non-appearance of menstruation, because of the appearance of a swelling in the abdomen, or because of disturbance of micturition. Retention of urine frequently occurs. As the bladder with the uterus is pushed upwards by the distended vagina the urethra is stretched, and naturally the slight pressure on it causes obstruction. On local examination there will be found at the vaginal orifice a bulging membrane, the surface of which has a dull purple colour. Superficial to this may be seen the annular or cribriform membrane representing the hymen (Fig. 318). Rectal examination, always advisable in such cases, reveals

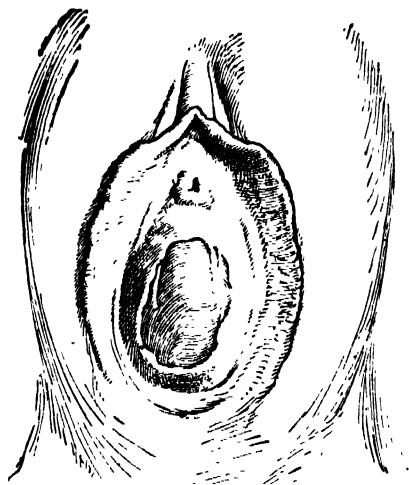


FIG. 318.—Obstructing Membrane at Vaginal Entrance. Hymen seen as an annular membrane outside the obstruction.

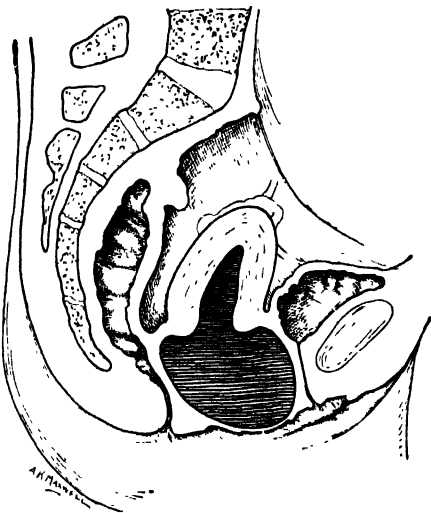


FIG. 319.—Haematocolpos showing great distension of Vagina by retained Menstrual Blood. The uterus is also slightly distended (haematometra). This causes elongation of urethra.

a cystic swelling low in the pelvis. The obstruction to the escape of the menstrual flow is due in most cases to a failure in the canalisation of the lower ends of the Müllerian ducts (p. 94), the persisting membrane lying somewhere above the level of the hymen: in other cases the hymen itself is imperforate, and seals over the vaginal orifice completely.

The extent to which this swelling causes distortion of the reproductive canal varies with the height at which the septum exists: the higher the septum, the earlier will the uterine cavity become involved in the swelling. In some cases the amount of retained fluid is so great as to cause a swelling palpable at the pelvic brim, on the top of which may be felt the uterus as a small, hard, rounded organ (Fig. 318). Fortunately, the fluid is usually contained in the vagina, the walls of which distend easily; the condition is then

described as *hæmatocolpos*. It may extend to the uterine cavity, forming a *hæmatometra* (Fig. 319), and in the most extreme cases it may distend the Fallopian tubes, forming *hæmatosalpinx*. In the two latter conditions the wall of the uterus may have lost its muscle tone, a very important factor in the treatment of the condition. When the retained fluid leaks into the peritoneal cavity, local irritation results, adhesions form, and the abdominal ostia of the tubes may become sealed.

The treatment in the *hæmatocolpos* type is simple: a cruciform incision is made in the membrane which bulges at the vulva, and the free edges are removed with a pair of scissors. A tarry fluid escapes—the cavity should be washed out with normal saline solution. Strict asepsis must be observed in such operations, because infection may produce very disastrous results. Where the condition has progressed to *hæmatometra* and *hæmatosalpinx*, this treatment may be unsatisfactory because of the risk of a spread of infection through the atonic uterus to tubes and peritoneal cavity. In such cases abdominal exploration is advisable. Although complete removal of the uterus and sometimes of the tubes may be required (if the condition of tubes precludes more conservative measures), such radical measures are very seldom necessary.

TRUE PRIMARY AMENORRHŒA.—This term is applied to cases in which menstrual function has not appeared at an age well beyond that at which puberty should occur. Delayed menstruation has already been referred to (p. 774). This appears to be associated in some cases with a hereditary or familial tendency; but pronounced primary amenorrhœa generally results from defects in the development of the reproductive organs themselves. Absence of the ovaries is very rare and the size of the ovary does not give a measure of its functional value; ovaries are found in which no Graafian follicles can be identified. Absence of the uterus is also rare, but underdevelopment frequently occurs and can be demonstrated fairly easily. The forms of uterine hypoplasia associated with amenorrhœa are the *rudimentary* and *fœtal* types (p. 99). The *pubescent* type (p. 100) is generally associated with scanty periods, and sometimes with complete amenorrhœa.

Primary amenorrhœa may occur also in association with underdevelopment of some of the other endocrine glands, as in cretinism, dystrophia adiposo-genitalis and pituitary infantilism. Irregularities in the development of the suprarenal cortex may be associated not only with amenorrhœa, but also with *hirsutus*, and the male distribution of pubic hair. In many cases of primary amenorrhœa, the endocrine factor appears to be hypofunction rather than a defect in structural development.

In addition to the congenital lesions described, diseases which affect the reproductive organs between birth and puberty may prevent the onset of menstruation. Such diseases are tuberculous affections

of the uterus, tubes or ovaries, and gonococcal lesions acquired in childhood. Acute appendicitis in childhood may cause a widespread involvement of ovaries and tubes, with destruction of ovarian function.

Other conditions as anæmia, pulmonary tuberculosis, diabetes and malnutrition, may cause delayed menstruation, primary amenorrhœa or secondary amenorrhœa. The production of amenorrhœa by debilitating diseases may be secondary to the effect of such diseases on the endocrine glands. Excessive mental strain, excessive physical development, acute illnesses and shock are more common causes of secondary amenorrhœa, but the incidence of these causes at the appropriate age may lead to primary amenorrhœa.

Diagnosis and Treatment.—In all cases of primary amenorrhœa, consideration should first be given to possible systemic factors such as anæmia, diabetes and tuberculosis. Where the appearance of the patient suggests an endocrine factor, the basal metabolic rate and sugar tolerance should be estimated, and a skiagram of the base of the skull obtained. Should such extragenital factors be found, treatment should be carried out according to the lesion identified.

Poor development of the secondary sex characteristics may indicate a primary ovarian deficiency with associated uterine hypoplasia. Normal appearance of the secondary sex characteristics suggests a failure of development of the Müllerian duct system alone. Where a determining cause has not been identified, the patient should be examined under anæsthesia so that the presence and degree of development of the vagina, uterus and ovaries may be determined. The prognosis is very poor in cases of marked underdevelopment, and where development has been disturbed by extensive inflammatory lesions. Where the uterus is well developed and the ovaries are palpable, the prognosis is good, and best of all where, though there is no menstrual discharge, there is periodic molimen.

In the days before the hormone control of the reproductive organs was appreciated, cases of slight genital hypoplasia were treated by attention to nutrition and exercise, and the administration of such medicines as iron and arsenic. Such treatment still forms a useful adjunct to the more specific types of treatment now available.

Hormones may be used in the treatment of primary amenorrhœa, either to stimulate the ovary by gonadotropins and thus to procure development of the reproductive organs, or to provide by substitution the ovarian hormones as they occur normally in the menstrual cycle. By the administration of the gonadotropic hormone in the active form, recovered from the serum of pregnant mares, defective ovarian function may be stimulated to the complete development of Graafian follicles and ovulation, with the associated secretion of oestrone. For this purpose it is recommended that 400 international units of seral gonadotropin be injected intramuscularly daily during the first two weeks of an arbitrary cycle (should there be no suspicion of a suppressed

cycle), followed by a further two weeks during which no treatment is given, and at the end of which a menstrual period may be anticipated. This system of treatment should be continued through three or four monthly cycles.

By the administration of œstrone, the undersized uterus may be stimulated to further growth, and even to complete functional activity. It is recommended that 10,000 to 50,000 international benzoate units of œstradiol be injected twice weekly for five or six weeks. Within recent years the synthetically prepared œstrogens, and more especially stilbœstrol, have largely displaced the "biological" œstrogens in the clinical field, as they may be taken in tablet form by mouth and are far cheaper. During œstrogenic therapy, the associated hyperæmia of the endometrium may give rise to a sanguineous discharge from the uterus which may be mistaken by the patient for true menstrual discharge. Should the administration of œstrogen be suddenly stopped, there may be a discharge, not only of blood, but also of degenerated endometrium, which on histological examination shows no evidence of secretory activity. *Those forms of hormone stimulation are only likely to be effective where the degree of hypoplasia or hypofunction is slight.*

Treatment by substitution also is only likely to be effective in cases of slight hypoplasia or hypofunction. Estrone is administered throughout an arbitrary cycle of twenty-eight days in amounts corresponding to the variations in concentration of circulating œstrone during the normal menstrual cycle: in the latter part of this period, progesterone is administered to produce the secretory phase of the cycle. Five injections, each of 50,000 I.B.U. of œstradiol, or daily oral doses of 1 mgm. of stilbœstrol, should be distributed over the first twenty days of the cycle, and then for the next five days there should be a daily injection of 5 mgm. of progesterone. This course of treatment may give rise to a menstrual discharge either at the end of the first cycle, or after one or two such cycles. The administration of the ovarian hormones may be followed by the administration, about the middle of the cycle, of the gonadotropic hormone of the pituitary gland—1200 international units of gestyl (seral gonadotropin)—as a single intravenous dose. Those forms of hormone therapy are at present rather expensive, and as progesterone, the gonadotropins and the concentrated preparations of œstrone must be given by injection, the course of treatment may be exacting for the patient.

The stimulation of the ovaries by minimal doses of X-rays has also been practised: the results here, too, have been uncertain owing to the difficulty of gauging the appropriate and safe dose.

Secondary Amenorrhœa.—This is the term applied to the condition where the menstrual function has stopped after having been completely established. The causes may be associated with lesions (1) in the reproductive organs themselves, (2) lesions in the endocrine system or (3) general diseases.

(1) SECONDARY AMENORRHŒA DUE TO LESIONS IN THE REPRODUCTIVE ORGANS.—(a) *Ovaries*.—Amenorrhœa follows the surgical removal of the ovaries; the reported persistence of menstrual periods after such an operation is certainly due to the incomplete extirpation of ovarian tissue. The same result follows the employment of X-rays to produce sterility. Bilateral ovarian tumours to such an extent as to destroy all active tissue of the ovaries may lead to amenorrhœa, but ordinarily a cyst of ovary does not affect menstruation (p. 1017).

(b) *Uterus*.—The surgical removal of the uterus results in amenorrhœa. Where the cervix has been left, along with some ovarian tissue, there may be a slight periodic discharge of menstrual fluid arising from the upper portion of the uterine remnant.

In the type of secondary amenorrhœa associated with superinvolution of the uterus, and formerly ascribed to puerperal sepsis, it has been found that the essential lesion is a partial necrosis of the anterior lobe of the pituitary gland (p. 661). The whole clinical picture is that of Simmonds' disease. This condition has been successfully treated by hormone therapy as described for primary amenorrhœa.

(c) *Acquired Atresia of the Cervix or Vagina*.—Such atresia may result from trauma occurring during parturition. Operations for the repair or the amputation of the cervix may be followed by cicatrization, and lead to a similar result. The uterine discharge is unable to escape, and accumulates to form the condition of secondary hæmatometra; the menstrual fluid may be dammed back in the tubes to form hæmatosalpinx, or pass through to collect in the pouch of Douglas. This condition requires treatment by surgical means.

(2) SECONDARY AMENORRHŒA DUE TO ENDOCRINE LESIONS.—

(a) *Thyroid Lesions*.—Amenorrhœa may occur as part of the clinical picture of myxœdema: the investigation of a large number of such cases has shown that amenorrhœa occurs in patients near the menopausal age, but that in younger women menorrhagia is more common. While the early stages of exophthalmic goitre are usually associated with menorrhagia, the further development of the disease produces degenerative changes in the uterus and amenorrhœa. Here the menstrual function improves along with the patient's general condition following the administration of thyroid extract.

(b) *Pituitary Lesions*.—Lesions which lead to a diminution of the secretion of the anterior lobe of the pituitary gland cause amenorrhœa. This has been found in a case where a fracture running through the *sella turcica* caused damage to the pituitary gland. More typical is the association of amenorrhœa with *dystrophia adiposo-genitalis* (p. 62): the patients show the characteristic obesity in shoulders, busts, abdomen, buttocks and hips, with occasionally masculine distribution of hair. Pituitary infantilism (p. 62) causes primary amenorrhœa. Acromegaly in its advanced stages is associated with amenorrhœa and sterility. Cushing has described the association of amenorrhœa with small

basophil adenomata of the pituitary gland. The patient shows plethora with an excess of subcutaneous fat in the face, neck and trunk : there is also hypertrichosis and hypertension. The association of puerperal necrosis of the gland with superinvolution has just been described with uterine causes of secondary amenorrhœa.

(c) *Suprarenal Lesions*.—Addison's disease produces amenorrhœa. Hypernephromata lead to masculinity with atrophy of the uterus, ovaries and mammary glands.

Where the endocrine lesion is due to tumour formation the removal of the tumour may restore menstrual function, provided that degenerative changes in the reproductive organs have not gone too far. Otherwise little can be done for these conditions.

(3) SECONDARY AMENORRHŒA DUE TO GENERAL CAUSES.—(a) *Psychic Factors*.—Amenorrhœa may follow sudden shock, such as the receipt of the news of the death of a near relative. Most of the grosser forms of mental disturbance, especially of the depressive type, are associated with amenorrhœa ; the return of the periods in those women is regarded by alienists as one of the most important indications of the patient's progress towards recovery.

The dread of pregnancy in unmarried women who have incurred such a risk may be followed by a temporary amenorrhœa. The desire to bear a child, when it leads to the condition of *pseudocyesis*, is associated with a psychic amenorrhœa (p. 163).

There is a type of case which it is very hard to classify, and which may be included here. The most usual story is that the patient caught a chill, had her clothing soaked with rain, or went sea-bathing during a menstrual period, and that menstruation has not returned since. So little cause can be found locally in such conditions that there seems to be good reason for including them among the psychic types.

(b) *Anæmia*.—Anæmia is a common cause of amenorrhœa in young women. Pernicious anæmia may be associated with menorrhagia, but in its later phases leads to amenorrhœa.

(c) *Tuberculosis*.—One of the earliest incidents in a case of pulmonary tuberculosis may be the occurrence of amenorrhœa, and this condition persists, as a rule, throughout the course of the disease. The important part which the deposition of calcium plays in tuberculous lesions has been given as the reason for the early menstrual disturbance.

(d) *Specific Fevers and other Debilitating Diseases*.—The onset of any of the acute specific fevers usually produces amenorrhœa. Exceptional among such fevers is influenza, the onset of which may be associated with a period, premature in incidence or excessive in amount. In other debilitating conditions, such as the terminal phases of cardiac disease, renal disease, cancer cachexia and diabetes, the menstrual periods seldom persist. Simple inanition produces the same result : amenorrhœa is usual in cases of anorexia nervosa.

(e) *Chronic Poisoning*.—Continued indulgence in morphia or cocaine

sooner or later causes amenorrhœa. Chronic lead poisoning, now seldom met with, produces a similar result. Prolonged indulgence in alcohol is said to have the same effect ; but this development is seldom seen.

(f) *Other Causes.*—Change of occupation, of environment and overstudy may cause amenorrhœa. All these conditions operate in the case of young women who come from the country to cities to attend college, or go into business or domestic service. Any one of these causes, however, may give rise to this condition. General metabolic derangement is the cause in women who, leading an idle life, with over-indulgence in food and other luxuries, suffer from amenorrhœa and sterility.

Treatment.—The psychic type is a fairly difficult one to treat, including even the type where amenorrhœa follows a “chill” acquired during a period. Tonics and abdominal massage should be commenced as early as possible, because the abeyance of menstruation is attended by atrophic changes in the uterine musculature. Hormone treatment of the type described for primary amenorrhœa may prove helpful in such cases (p. 778) and the response to such treatment is usually better than in the primary type. The anæmic types require treatment for the blood condition present. The effective treatment of pulmonary tuberculosis or specific fevers will restore the periods ; in advanced cardiac and renal cases amenorrhœa is of little importance.

Unsuitable environment and occupations should be changed ; the metabolic type often responds to regulated diet and exercise. Little advantage may be expected from the use of the emmenagogues which are so freely advertised : at best, they act as simple tonics by improving the anæmia which is so frequently an associated condition ; at worst, they are thinly veiled abortifacients.

ANOMALOUS UTERINE HÆMORRHAGES

(a) *Of Local Origin*

At the outset it is important to remember that women sometimes complain of bleeding from the vagina when in reality the blood loss arises from hæmorrhoids or from a superficial source in the vulva, such as a urethral caruncle. Further, a vaginal hæmorrhage may not be uterine in origin but originate in the vaginal walls from such conditions as tumour growth and ulcerations caused by pessaries.

Abnormal uterine hæmorrhage may occur as (1) hæmorrhage before puberty and the normal onset of menstruation, (2) excessive or irregular hæmorrhage during the reproductive life, or (3) hæmorrhage after the menopause.

(1) **Hæmorrhage before and at Puberty.**—Bleeding from uterus is comparatively rare in infancy and childhood. *At birth, or immediately*

after birth, a fairly free and fresh bleeding may occur from the uterus and last for a day or two. It would seem certain that such bleeding has its origin in a hormonal cause. It is associated with proliferative activity of the endometrium of the infantile uterus of an œstrogenic nature, probably due to the maternal hormones which have passed over into the foetal circulation before birth. The bleeding is to be regarded as an "arrest bleeding" following a break-down of the endometrium with the drop in blood œstrin after birth. Such neonatal bleeding is rarely of clinical significance, and subsides spontaneously within a short period. A similar cause probably underlies the engorgement of the breasts with milk, which occasionally occurs in the infant after birth; either sex may be affected, although it is rather more common in female infants.

Menstruation may, in rare cases, commence at an abnormally early period, even as early as the third year. A case has been recorded of such precocious menstruation beginning between the second and third year in a child who gave birth to a baby at the age of nine.

Uterine bleeding of a more pronouncedly pathological nature may occur in the case of mucous polypi or malignant growths of the uterus or ovaries. A very grave and, fortunately, very rare cause of vaginal bleeding in early life consists of multiple polypoidal growths from the vaginal cervix and vaginal wall. We have seen one such fatal case in a child of three, in which the cavity of the vagina at the first examination was found to be greatly distended by a mass of such polypi. The polypi were soft and slimy, and microscopically consisted almost entirely of markedly myxomatous tissue enclosed by a shell of squamous epithelium (*vide* p. 983).

Menorrhagia of Puberty or Adolescence.—This is a special clinical type occasionally encountered, in which the onset of menstruation is associated with profuse blood loss. This menorrhagia may attend the first menstrual period or it may occur after one or more normal periods have been passed. It may be very severe and even alarming. On occasions it may continue for several weeks, and the profuse loss may punctuate several periods before the normal rhythm is properly established.

In such cases there is usually no gross pathology, and we are driven to postulate ovarian and other endocrinal disharmony as the cause—in some individuals a little time may elapse before perfect harmony of function is established.

The condition should be treated on lines similar to those indicated later in this chapter when other menorrhageal disturbances of endocrinal origin are discussed. In some instances the bleeding is so severe that vaginal plugging is necessary; this must be done tightly and to do this an anæsthetic may have to be administered. Blood transfusion may sometimes be indicated.

It should never be forgotten that uterine bleeding before puberty

may arise in association with pregnancy. It is well known that ovulation and impregnation can take place in a girl before the onset of menstruation, and the presence of vaginal bleeding may connote in such a patient the occurrence of abortion or antepartum hæmorrhage.

(2) **Excessive and Irregular Uterine Hæmorrhage during Reproductive Life.**—Under this heading fall the great bulk of the cases of abnormal uterine bleeding. Clinically we may divide such abnormal uterine bleeding into :—

(a) *Menorrhagia*, where there is an excessive loss at the menstrual period with or without a prolongation of the duration of the period itself.

(b) *Epimenorrhœa*, or *polymenorrhœa*, where the periods occur too frequently. Thus, instead of occurring every four weeks, they may assume a more or less regular rhythm of two or three weeks. In such instances there is frequently menorrhagia in addition to the increased frequency.

(c) *Metrorrhagia*, where the bleeding occurs between the menstrual period or takes the form of a continued bleeding extending beyond the normal interval.

Abnormal uterine bleeding may arise from local conditions in the uterus and ovaries or from general systemic or endocrine states.

Local Causes.—The most common cause of abnormal bleeding during reproductive life is found in the conditions incidental to pregnancy. This question has been discussed fully in previous sections of this work, and it need not be considered in any detail here. It should be remembered that long-continued irregular bleeding may occasionally arise from placental fragments retained in the uterus subsequent to abortion or labour. So, in ectopic pregnancy, uterine bleeding is typically found at the stage when the disintegration caused in the tubal wall is leading to damage or death of the ectopic ovum; the bleeding in such cases arises from the uterine decidua (p. 350).

Amongst the common local causes of excessive and irregular hæmorrhage, which are of a more purely gynæcological nature, we have uterine tumours (fibromyoma, adenomyoma, mucous polypus, carcinoma, sarcoma, and chorionepithelioma), conditions causing pelvic congestion, such as acute and chronic salpingitis, cervicitis, cellulitis, and sexual excitement, especially about the time of marriage. Infective conditions of the endometrium (acute and chronic endometritis) and musculature of the uterus (metritis) may result in uterine bleeding, and, formerly, these conditions were believed to constitute common ætiological factors. Whilst they cannot be altogether excluded, there is reason for the belief that they are probably operative only comparatively rarely (see p. 787). Ovarian tumours may be associated with abnormal uterine bleeding. Thus acute strangulation of such a neoplasm after torsion of the pedicle may occasionally be accompanied by this symptom. Menorrhagia and metrorrhagia may likewise be a symptom in cases of malignant growths of the ovary. The rare

granulosa cell tumour of the ovary is characteristically associated with irregular and excessive uterine bleeding. Non-malignant ovarian tumours do not commonly cause alterations in the menstrual type. Where, however, the new growth involves both ovaries and results in a destruction of the endocrinal elements, amenorrhœa may occur.

The *pathology, clinical features, differential diagnosis and treatment* of the above states are discussed under the appropriate headings.

General Systemic Disease.—Irregular and excessive uterine bleeding frequently occurs in association with systemic disease and, sometimes, as in such conditions as pernicious anæmia, purpura, leukæmia, hypertension and chronic nephritis, there is good reason for considering the abnormal uterine bleeding as a symptom of the general state. At the same time the bleeding may in such cases arise as the result of a secondary disturbance of the endocrine factors that control menstruation (anterior pituitary, ovary).

(3) **Postmenopausal Hæmorrhage.**—Uterine bleeding subsequent to the menopause is always to be regarded as a grave symptom in view of the fact that in a high proportion of cases it denotes a malignant growth. In a consecutive series of 155 hospital cases recently analysed by one of the authors, malignancy was present in 68—i.e. 44 per cent. of the total.

The most common individual cause of postmenopausal bleeding is carcinoma of the cervix; this constitutes the cause in from 20 to 30 per cent. of all cases. It may be found even in women in extreme old age. *Carcinoma of the body* has its chief incidence after the menopause, although, compared with cervical malignancy, it is relatively uncommon, comprising about 8 to 10 per cent. of the total. Cervical cancer is rare in nulliparæ, whilst corporeal cancer is about equally common in parous and nulliparous women. Other malignant conditions—each relatively rare—which may induce postmenopausal bleeding, are *malignant ovarian neoplasms, carcinoma of vagina or vulva, and sarcoma* in any part of the genital tract.

In over 50 per cent. of cases postmenopausal bleeding is dependent upon benign factors. Amongst the most common causes are *mucous polypus* of the uterus (that growing from the cervical mucosa being more common than that from the corporeal mucosa) and *submucous fibromyomatous growths*. In a considerable proportion of cases (about 15 per cent.) curettage fails to reveal any of the above pathological conditions. There may be nothing revealed except some endometrial thickening, when microscopic examination suggests the condition to be dependent upon ovarian dyscrasia. In such cases there is sometimes incontrovertible evidence of a kind of ovarian "rejuvenescence." In still other cases nothing abnormal is discovered in the uterus, and in not a few it may be impossible, even by deep curettage, to obtain anything more than shreds of mucous membrane. Nevertheless curettage commonly results in an arrest of the bleeding.

In a considerable number of instances the bleeding is associated

with *genital prolapse*, and is derived from rupture of small vessels on the congested or ulcerated surface mucosa of the prolapsed vagina or cervix; ulcerated areas are often present, due to irritation of clothing or pessaries. In such cases the bleeding is usually slight, consisting of the occasional escape of "spots" of blood or a blood-stained leucorrhœa.

Included amongst the less common causes of a non-malignant character which produce postmenopausal hæmorrhage, we have to note *chronic cervicitis*, *urethral caruncle*, *senile endometritis*, and *simple ovarian neoplasms*. The rare class of ovarian neoplasm, termed *granulosa-cell tumour*, tends to develop in later life, and it is typically accompanied by postmenopausal bleeding (p. 1010).

The accompanying table, based upon an analysis of 937 cases by Fahmy, shows the percentage frequency of the various causal agencies :—

ORDER OF FREQUENCY OF VARIOUS CAUSES OF
POSTMENOPAUSAL HÆMORRHAGE ¹

Benign 533 ; 56·88 per cent.
Malignant 404 ; 43·12 per cent.

	Number of Cases.	Percentage.
1. Carcinoma of cervix uteri	241	25·72
2. ? Ovarian dysfunction, diagnosis doubtful	141	15·05
3. Polypus : Mucous and fibro-adenomatous	114	12·17
4. Carcinoma of corpus uteri	93	9·82
5. Prolapse : Genital (with or without friction ulceration)	86	9·17
6. Fibromyoma and fibroid polypus : Uterine	64	6·83
7. Cervicitis and vaginitis	40	4·27
8. Ovarian neoplasm : Malignant	32	3·52
9. Caruncle of urethra	27	2·88
10. Senile endometritis	20	2·13
Ovarian neoplasm : Benign	20	2·13
11. Carcinoma of vagina	12	1·28
Vaginal ulceration due to pessary	12	1·28
12. Carcinoma of vulva (labium)	10	1·07
13. Sarcoma of uterus, corpus, fibroid and retroperitoneal	8	0·85
14. Carcinoma of clitoris	3	0·32
15. Carcinoma of urethra	2	0·21
Prolapse of urethra	2	0·21
Tuberculous endometritis	2	0·21
Myxofibroma of vagina	2	0·21
Hyperplasia (constitutional - e.g. cirrhosis of liver)	2	0·21
16. Sarcoma in cervical stump	1	0·11
Carcinoma of peritoneum (secondary to breast tumour)	1	0·11
Malignant papilloma of bladder	1	0·11
Tuberculous granuloma of urethra	1	0·11
	937	99·98

¹ Fahmy, E. C., *Journ. Obst. and Gyn., Brit. Emp.* (1933), 40, 506.

Differential Diagnosis.—For a discussion of this question the reader is referred to the chapters dealing with the varying conditions mentioned above. Here, however, it is important again to emphasise the fact that in every case *postmenopausal bleeding should be regarded as arising from a malignant condition until this has been excluded by a complete examination*. Where the possible vulvar and vaginal conditions are excluded the cervix should be investigated, and where there is no polypus present and cervical carcinoma can be eliminated the uterus should be curetted so that material can be obtained for microscopic examination.

Treatment.—This is discussed under the relevant diseases.

(b) *Due to Endocrinal Dyscrasias*

Menorrhagia of adolescence has been already referred to (p. 783). Here we discuss the large group of cases of bleeding uteri, which formerly were unsatisfactorily grouped under such headings as chronic glandular endometritis, subinvolution, chronic metritis, and fibrosis uteri, which are now recognised to be an expression of disorders affecting the hormonal control of the uterus.

We are still largely ignorant of the ultimate causes of these disorders, and the differing groups have not yet been defined on an accurate endocrinal basis. Until we are in possession of a knowledge of the endocrinal glands primarily at fault in the varying clinical conditions and of the manner in which their hormonal activities deviate from the normal, our descriptions of ætiology must be largely tentative, and our efforts at treatment must be either empirical or symptomatic or both.

The first fact to be noticed is that, in a large group of cases of excessive or irregular uterine bleeding, pronounced and characteristic changes can be discovered in the ovaries on those occasions when, for example, after hysterectomy or other abdominal operations, these are available for study. The ovarian changes so found consist for the most part of alterations that connote a distortion of the ordinary cycle of ovulation and luteinisation. In many instances there is evidence that this distortion is due to local ovarian disease, as, for example, when chronic pelvic inflammation results in the ovary being strangled in adhesions that prevent the normal rupture of the follicles, and that lead to their undergoing atresia and cystic distension. In many other instances there is no evidence of such local disease, and it is presumed that the disturbance of the follicular rhythm springs from some alteration in the anterior pituitary control.

The next fact to be emphasised is that it is now recognised that the changes, which are characteristically found in the uterus in such cases, and which are commonly in the nature of an active proliferation of the mucous membrane and often, also, of the muscular wall, are secondary to the changes present in the ovary.

There are two main groups of ovarian disorder that so far have been identified in such cases, and these can be separated from one another in regard to their secondary uterine pathology and their symptomatology. In the first group—*metropathia hæmorrhagica* (Schroeder)—there is an arrest of ovulation with the production of one or more cystic follicles in the ovary and an absence or a limitation of corpus luteum formation. In the second group the corpora lutea form, but not infrequently the ovarian tissue round the follicles is abnormally congested. We shall describe these two groups separately.

Metropathia Hæmorrhagica (see Fig. 320).—The *ovarian changes* in this condition, as we have seen, consist of a cytolysis of atretic follicles with a corresponding absence or defective formation of corpora lutea. The *uterine changes* are believed to be due to an excessive or continued stimulation by the oestrin elaborated by the follicles in the absence of the co-ordinating effect of the progestin of the corpus luteum. The endometrium undergoes a diffuse thickening. The glands are hyperplastic, the nuclei are centrally or irregularly disposed in the cells and mitotic figures are present. The glands are irregular in shape and may become cystically dilated. On section the histological picture is then suggestive of "Swiss cheese." The cystic glands may be so large as to be visible to the naked eye. There is no premenstrual change in the glands because of the absence of progestin. The stroma is increased in amount, it is congested, and scattered necrosis is present. The muscular wall frequently undergoes thickening from true myohyperplasia. The general features of the pathology are well represented in Figs. 320, 321.

The *ætiology* of the ovarian changes have not been fully determined. In a considerable number of cases the women exhibit evidence of general systemic disease, for example, chronic cardiac or renal disorder, hypertension, chronic gastro-intestinal trouble, etc. Again, it may be that the gynæcological condition owes its origin to a pituitary-ovarian dyscrasia provoked by this systemic disease, or possibly independent of it. On these questions further investigation is required.

CLINICAL FEATURES.—*Metropathia hæmorrhagica* is found at any phase of reproductive life. The excessive *bleeding of puberty* (p. 783) comes into this category as a comparatively rare manifestation of the condition in early years. The great bulk of the cases are found in later years, the chief incidence being between the ages of thirty-five and forty-five. The characteristic symptom is *metrorrhagia*, namely, a continued bleeding unconnected with menstruation and associated usually with a disturbance of the usual menstrual rhythm. It is interesting to note that before the onset of the bleeding there frequently is a *short period of amenorrhœa*, lasting for six weeks or two months. Sometimes the menstrual rhythm is not disturbed and the condition reveals itself as a lengthened and excessive flow or *menorrhagia*. The bleeding is not usually at any time severe; it is rather of the nature of

a somewhat excessive or long-continued period. Where the bleeding persists over a long interval of time *anæmia* may be marked. *Pain* is not commonly a prominent feature, although not infrequently the

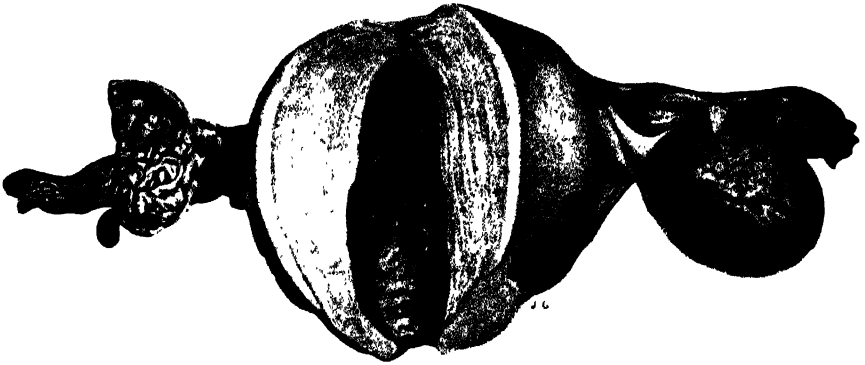


FIG. 320.—Uterus and Appendages in case of Metropathia Hæmorrhagica.

Note (1) myohyperplasia of uterine wall; (2) thickening and polypoid formation in mucosa; (3) follicular cyst in one ovary; (4) atrophic ovary on other side. There is an absence of luteal tissue.

patients complain of a sense of fullness and discomfort in the lower abdomen.

DIAGNOSIS.—This is usually easy and is based on the history of irregular or excessive vaginal bleeding in the absence of any pelvic pathology, except some uniform uterine enlargement. The uterus may be so large as to suggest fibromyoma. On some occasions the ovary, enlarged by the follicular cyst, can be felt bimanually. At puberty the clinical features are alone conclusive evidence, but in later years, especially towards the menopause, when the condition is more prone to develop, there are other competing causes of irregular uterine bleeding which demand exclusion. The chief difficulty is usually in distinguishing the metropathic uterus from a uterus enlarged uniformly with a small *fibroid*. *Carcinoma* is a frequent source of irregular bleeding in later years, but in metropathia there is no fetid discharge, and examination reveals no evidence of the induration and friability



FIG. 321.—Endometrium from case of Excessive and Irregular Uterine Hæmorrhage due to Ovarian Dysfunction (Metropathia Hæmorrhagica).

Note the great irregularity in the glands, many of which are cystic. On the left side there is a necrotic patch.

characterising cervical cancer, whilst corporeal cancer is extremely rare until after the menopause. In a woman over forty it is sometimes difficult to determine whether the irregular bleeding should not be regarded as denoting an *impending menopause*, especially if there has been a previous history of one or two months' amenorrhœa. Finally, the bleeding of metropathia following on a period of amenorrhœa may suggest *abortion*. In all cases the final diagnosis rests on *curettage* and the microscopic examination of the material removed; as we shall see, this may result in a cure of the symptoms.

TREATMENT.—This consists, in the first place, in *curettage* which, besides enabling a definite diagnosis to be made, may occasionally (in 15 to 20 per cent. of the cases) be followed by relief of the symptoms. In some instances the ovary containing the palpably enlarged cystic follicle may be pressed down into the pouch of Douglas and the cyst evacuated by syringe through the posterior fornix. Should the bleeding recur, as it commonly does, endocrine therapy should be instituted. This aims at stimulation of the ovary with a gonadotropic extract for the purpose of inducing ovulation and corpus luteum formation. The pituitary-like hormone from pregnant urine (prolan) given hypodermically every second day over a period of two or three weeks has been strongly recommended by some gynæcologists, but in our hands it has been very uncertain in its action. It would, indeed, seem to be clear that this "particular" hormone has little or no stimulating effect on the human ovary. Better results have been obtained with the gonadotropic hormone obtained from the serum of pregnant mares and recently placed upon the market. Davis and Koff¹ have shown that in adequate dosage this can effect ovulation in the human ovary. It should be given by intramuscular injection for five days in a daily dose of 500 units. Repeated during two or three-monthly intervals it may re-establish the normal rhythm. At the time of writing, the treatment of dysfunctional bleeding with such gonadotropic extracts is still, however, in a tentative stage and no definite pronouncement regarding its value can be made. As an alternative to (or in conjunction with) gonadotropic therapy, progesterone may be employed. It should be given for three or four days in doses of 5 mgm.

Where relief is not obtained by any of the above procedures it may be necessary to adopt more drastic measures. For this purpose the production of an artificial menopause by X-rays or radium is now largely employed. It has been found that low-dosage irradiation of the ovaries with X-rays may produce a temporary arrest of menstruation for periods varying from three to twelve months, and that, thereafter, the normal rhythm may be recovered. This procedure is especially worthy of consideration in young women before hysterectomy is contemplated. The method is, however, attended with the

¹ Davis, M. E., and Koff, A. K., *Amer. Journ. Obst. and Gyn.* (1938), 36, 183.

risk, which should be represented to the patient, that it may end in permanent amenorrhœa and sterilisation. Further, it has been stated that radiation of the ovaries may cause damage of the ova with the creation of maldevelopmental defects in the fœtus in the event of a pregnancy supervening. There would, however, seem to be a tendency to discount the fear of such damage to the germ-plasma, and Murphy collected 600 cases with no evidence of subsequent foetal abnormalities. Waddington has pointed out that the damage to the genes produced by radiation is generally recessive, and that congenital foetal abnormality would occur only in the unlikely event of the marriage of two similarly affected individuals.

The intrauterine application of *radium* is also largely used for the production of an artificial menopause. Unless given in a dosage of at least 2,000 mgm. hours a permanent result cannot be guaranteed; a practice favoured by many is to introduce a cylinder containing 50 mgm. for forty-eight hours—i.e. giving 2400 mgm. hours (*vide* p. 926).

It should be remembered that in many instances, even where the immediate factors are endocrinal in nature, the primary cause of the irregular and excessive bleeding of functional origin may be more systemic than gynæcological. For this reason the general medical state of all such patients must be carefully investigated and treatment directed to any morbid condition discovered.

The success attendant on the conservative measures outlined in the preceding paragraphs has tended more and more to displace *hysterectomy*, and this is now reserved for cases in which general medical and endocrinal methods fail and where X-rays or radium is not available.

Excessive Bleeding from Other Kinds of Endocrinal Disorder.—The conditions gathered under *metropathia hæmorrhagica* conform to a group which is defined alike in its pathology and its symptomatology. In this place we have to review a large series in which the pathological basis for the bleeding is still wholly undetermined or only imperfectly understood. In this group the bleeding is of the nature of *menorrhagia*; that is, it punctuates periods which are more or less regular in their rhythm. It has been assumed that this excess is dependent upon an excessive hormonal secretion by the ovary. Certainly in some it is due to *hyperthyroidism* (p. 64). In many cases the rhythm is shortened, and instead of the former monthly interval the periods recur at a more or less regular rhythm of two or three weeks—*polymenorrhœa* or *epimenorrhœa*. In the ovary there is a corresponding speeding up of ovulation, so that in this sense we have here an increased activity of the ovary, probably due to some primary alteration in the *anterior pituitary lobe*. In the uterus there is usually a hyperplastic change in the endometrium, with an increase in the number and size of the glands and often a greater irregularity in their outlines. The stroma is usually increased in amount and typically exhibits marked congestion and

often free extravasation of blood. The muscular wall is frequently increased in thickness.

The ultimate cause of the endocrinal disturbance is at present unknown in this group, which embraces the bulk of the cases of excessive uterine bleeding of dysfunctional origin. The *age incidence*, as in the former group, proves that the disease is more prone to develop in women after the age of thirty-five, and more especially in women nearing the menopause, although it is frequently met with at earlier years. *Child-bearing* plays a prominent part, as in a high proportion the symptoms date from the birth of the last child. It is elsewhere pointed out (p. 911) that chronic pelvic infection, especially *cervicitis*, is of great causal significance—menorrhagia and epimenorrhœa are common in women suffering from chronic cervicitis, and treatment directed to this alone frequently relieves the bleeding.

DIFFERENTIAL DIAGNOSIS.—This involves the distinguishing of endocrinal menorrhagia from those other conditions that cause menstrual excess. In women over the age of thirty, fibromyomata of the uterus constitute the chief difficulty. Chronic salpingo-oöphoritis, from the pelvic congestion it creates, is often attended with menstrual increase. It is sometimes maintained, however, that the menorrhagia of fibroids and chronic tubal infection springs, as does the menorrhagia of cervicitis, from endocrinal disturbances.

TREATMENT.—This consists, in the first place, of *curettage*, and this may relieve the symptoms. An associated cervicitis is treated at the same time (p. 913). Progesterone (5 mgm. daily for four or five days) may arrest the bleeding. In severe and intractable cases the induction of an artificial menopause by means of radium or X-rays is indicated. Hysterectomy is seldom necessary.

LEUCORRHOEA

In the reproductive canal there are three principal secreting surfaces, the products of activity of which in perfect health are just sufficient to lubricate the surfaces, but which, under other conditions, may become so altered as to give rise to a copious discharge of fluid from the vaginal orifice. The characters of the mucous membranes of these canals, vaginal, endocervical and uterine, have been described (pp. 13, 17, 20). The *vaginal secretion* takes the form of a watery transudate, which moistens the shed epithelial cells and produces a white curd. The mucous membrane, including the shed epithelial cells, has a very high glycogen content. The deposit of glycogen in the epithelium is closely associated with the action of ovarian hormones (p. 48). There is little glycogen before puberty, after the menopause, and also in cases in which the ovaries have been removed, or their secretory activity destroyed by radiation therapy or by disease. The healthy vagina during reproductive life contains large numbers of

Döderlein's bacillus (p. 642). Its presence and activity appear to be dependent on the presence of glycogen in the mucous membrane, but it is difficult to determine whether the acid reaction of the normal vaginal secretion is entirely due to the products of activity of the bacillus, or to the presence of some enzyme in the tissues, which breaks down the glycogen to lactic acid. The reaction of the secretion of the healthy vagina is highly acid, the hydrogen-ion concentration ranging from 4 to 5. The reduction of this acidity, for example, by the alkaline menstrual discharge, may allow exacerbations of activity of organisms which have been inhibited by the acid secretion.

The *cervical glands* produce a clear mucus which is alkaline in reaction: hypersecretion of those glands, resulting from bacterial or other form of irritation, may produce large amounts of mucus which, on reaching the acid vagina, becomes coagulated and opaque. These compound racemose glands offer a very favourable nidus for organisms, and it is here that chronic puerperal and gonorrhœal infections remain most obstinate.

Unfortunately the glandular epithelium of the cervical canal has a tendency to spread beyond the line of the external os, and to form patchy secreting areas on the vaginal surface of the cervix—viz., cervical adenoma or cervical erosion (p. 907).

The *glands of the corporeal endometrium* produce a serous, albuminous fluid, non-mucoid in character. Except in gross infection of the endometrium itself, or of neoplasms arising from that surface, it is unlikely that the secretion of the glands of the body of the uterus add much to the discharge escaping from the vagina.

The term *leucorrhœa* should include only those conditions in which there is merely an excessive amount of the normal whitish secretion, referred to by patients as "whites." However, it has come to be applied rather loosely to practically all forms of vaginal discharge, other than hæmorrhagic or frankly purulent. The discharge is usually intermittent, occurring in greatest amount just before and just after each menstrual period: it may cause much irritation of the external genitalia and the surrounding skin, amounting to an actual *pruritus vulvæ*, especially in patients with a very sensitive skin (p. 888). Consideration of the varied sources of the secretion escaping from the vagina indicates how easily the discharge may be altered in character and amount by local irritation (mechanical, traumatic or infective), by neoplasms, or even by general conditions of health.

Ætiology.—*Mechanical and Reflex Causes.*—Congestion due to pregnancy, large pelvic tumours arising from the uterus or ovaries, chronic pelvic cellulitis or obstinate constipation may cause an increased flow. The vaginal surfaces during pregnancy are bathed by a cream-like secretion which may escape as a discharge. Under the microscope it is seen to contain numerous epithelial "squames." This "leucorrhœa of pregnancy" is a normal phenomenon and is an expression of the

increased oestrogenic activation of the vaginal mucosa. Mechanical irritation may result from pessaries, introduced in gynæcological treatment or employed for contraceptive purposes: a forgotten tampon or swab may account for most profuse discharge. The soft rubber ring pessary formerly so much employed in the treatment of prolapse of the vaginal walls in elderly women, is specially liable to cause profuse discharge. Frequent douching with antiseptics in improper dilution and certain medicated pessaries employed in contraception may cause considerable irritation to the vaginal mucous membrane. Erotic stimulation, sometimes merely from suggestion, but more commonly associated with excessive sexual intercourse or with masturbation, may be the cause. Reference may be made here to a form of infective vaginitis (non-gonococcal) acquired during intercourse from infected secretion retained behind a tight male prepuce.

Virginal and Senile Conditions.—Before passing to the traumatic and infective causes and those associated with neoplasms, we may consider some conditions which we have to deal with especially in virgins, though these conditions may be factors in other cases. General debility is frequently associated with excessive vaginal discharge: the debility factor is important in cases of tuberculosis, anæmia, etc. The cervical adenomata or erosions referred to below are common in such patients, and add an extra secreting surface.

In cases which prove resistant to thorough local treatment and to general tonic and hygienic measures, the persisting discharge appears to be associated with *disturbed ovarian function*, and with a diminution in the glycogen content of the vaginal mucosa (p. 48). In such cases the bacterial content of the vagina becomes altered—Döderlein's bacillus is no longer the prevailing organism, and the reaction of the secretion tends to become less acid. While this group of cases might be included with the infective type, it differs from the others in that the bacterial activity here is endogenous because of the lowered pH .

In a similar category may be included elderly women with excessive, frequently offensive, vaginal discharge: the senile changes in the vagina are associated with the disappearance of glycogen from the mucous membrane, and the supercession of Döderlein's bacillus by other organisms. In debilitated women of this type, particularly in those who have been condemned to wear pessaries, the bacterial activity and resulting ulceration may lead even to a blood-stained discharge.

Traumatic Lesions.—Traumatic lesions are important factors in parous women, though in nulliparæ the cervix may have been damaged during a gynæcological operation by the grip of a vulsellum forceps or by overstretching with metal dilators. Plastic operations on the cervix for the cure of dysmenorrhœa or sterility are much less frequently performed than they were a few years ago, but a cervix which had been operated on in such a way might later show the conditions to be described in the parous cervix. Laceration of the cervix

occurs not only in instrumental but also in spontaneous labours. The endocervical mucous membrane becomes exposed to the stimulation of the bacterial content of the vagina, and secretes very freely. This glandular epithelium tends to spread along the surface of even healed scars. When the cervix becomes hypertrophied as a sequel to such trauma, the secretion becomes even more profuse: such cases are frequently associated with the presence of retention cysts or Nabothian follicles (p. 908).

Neoplasms.—Neoplasms may act by producing hyperæmia, as in large uterine fibroids or ovarian tumours. A submucous fibroid, or a mucous, placental or fibroid polypus, may cause excessive discharge not only through hyperæmia, but also by irritation of the adjacent secreting surfaces, and later from infection of the tumour surface itself. When necrosis of a submucous fibroid or fibroid polypus occurs, the sloughing tissue becomes grossly infected, and the copious offensive vaginal discharge may resemble that from a malignant tumour. Cancerous growths of body and cervix give rise at first to a thin, watery secretion formed by the serous transudate from the vessels in the neoplasm: later the surface becomes necrosed, with gross infection of the tissue, causing a very profuse and offensive discharge. Again, the malignant growth may block the cervical canal and a pyometra result, which periodically discharges a foul smelling pus (p. 964). In cancer cases which have been treated with radium, a thin, watery vaginal discharge may persist for a long time.

Infective Lesions.—Bacterial action has already been referred to in the ætiology of virginal and senile leucorrhœa, in traumatic lesions and in the secondary infections of neoplasms. Similar conditions may arise in cases of retained products of conception. In lesions of purely infective origin, especially where the infection has been introduced, gonorrhœa is the most common cause (p. 868). Even after an apparently thorough course of treatment a discharge may persist, due to a residual infection in the endocervical glands. Following abortion or childbirth, there may also be a persisting endocervicitis. Tuberculosis of endometrium (p. 918) or more rarely of cervix may be associated with profuse leucorrhœa: the leucorrhœa associated with the debility resulting from tuberculous lesions elsewhere in the body has already been referred to. Infection of the endocervix and of the endometrium, though the latter is of less importance in the ætiology of leucorrhœa, may be due not only to the organisms already referred to but also to the streptococcus, staphylococcus, *Bacillus coli*, anaerobic bacilli, the pneumococcus or even the diphtheria bacillus. In children the vaginal walls may be invaded by pyogenic organisms, which would not be able to break through the resistant epithelium of the adult.

Parasitic Infections.—Recently much attention has been devoted to the study of the invasion of the vagina by the protozoon, *Trichomonas vaginalis*. This flagellate, motile parasite has been identified in a large

number of women : some investigators report its presence in the vaginal discharge in as many as 40 per cent. of women seeking gynæcological treatment, while it has been identified in 15 and even 20 per cent. of pregnant women attending antenatal clinics (p. 283). Less than one-third of the non-pregnant, and only about 12 per cent. of the pregnant women complained of local symptoms which could be attributed to the presence of the parasite. When symptoms do arise from this cause, there is a thick, yellowish, frothy or foamy discharge, acid in reaction, frequently offensive in odour, which causes much external irritation. The parasite is usually found in association with other organisms, though seldom with the gonococcus : a most important adjuvant is a gram-negative micrococcus, which produces the bubbles of gas found in the discharge. In severe cases the clinical condition may resemble an acute gonorrhœal infection ; the differential diagnosis is not difficult.

To detect the parasite, a drop of the discharge should be placed on a slide and a few drops of saline added. The slide is then examined microscopically when the *trichomonas* will be seen amongst the pus cells as mobile bodies with waving flagellæ.

While the parasite is found in a large proportion of women, it is usually present in small numbers, and only develops its pathogenic powers when the vitality of the vaginal mucous membrane has been impaired by local or general debilitating factors. It is frequently found in cases where there is some recent or old traumatic lesion of the cervix. The source of the parasite is unknown : while trichomonads are found in the human intestine, they seem to have different characters from that found in the vagina.

To cure vaginitis is easy ; to prevent its recurrence is difficult. Recurrence seems to take place readily during the menstrual period, when the acid reaction of the vagina is reduced. When recurrences occur, investigation should be made as to the state of both bladder and rectum, in which the parasite may be harboured. Reinfection may occur through the husband, a point to be remembered.

Fungi.—Fungus invasion of the vagina is met with in non-pregnant but more commonly in pregnant women, particularly in association with glycosuria to which they are particularly prone. The most common fungus is of the yeast type—viz., *Oidium albicans*, which may produce thrush-like patches on the vaginal walls or simply give rise to a watery vaginal discharge, sometimes containing white flakes. The invasion of the vaginal walls by the fungus makes more easy the penetration of the epithelium by the various pyogenic organisms which are found in this region of the body, and in such cases there may be a most profuse, thick, yellow vaginal discharge. Pruritus vulvæ may be a very distressing symptom, especially in view of the frequent association of this condition with glycosuria.

Special Conditions.—Occasionally there is a sudden escape of a

large amount of serous or muco-purulent fluid from the vagina. The complications of pregnancy which might lead to such a phenomenon have been discussed elsewhere (p. 285). In the non-pregnant a collection of pus may escape from a pyometra, due to the sudden clearing of the cervical canal by increased pressure, or by the further erosive action of the causal tumour. Considerable amounts of serous fluid may be discharged from a case of intermittent hydrosalpinx, the *hydrops tubæ profluens* (p. 1030). The normal valved character of the opening from the Fallopian tube through the uterine wall makes such a phenomenon rare. Much more rarely, there may be a similar escape of pus from a case of pyosalpinx because the inflammation in the tube closes the uterine opening.

In cases of fistulæ, either from the urinary tract or the bowel, urine or faecal material may escape from the vagina.

Treatment.—Leucorrhœa must be considered as merely a symptom. Its cure depends on the recognition and efficient treatment of the causal lesion. Where the cause is a traumatic lesion, a neoplasm or some specific infection, that condition should receive appropriate treatment. In the treatment of infections, medicated pessaries are more efficient and usually more convenient to the patient than vaginal douches: such antiseptics as lactic acid, salicylic acid, silver nitrate or acriflavine are made up in oil of theobroma or in proprietary excipients of the Spuman type, which produce a colloidal mass of foam after introduction into the vagina. Antiseptic douches may produce too great dilution of the natural acid secretion of the vagina: where a vaginal douche is used lactic acid in a solution of 1 in 500 or ordinary warm tap water is most suitable.

The effectiveness of such therapy is aided by the administration of the follicular hormone of the ovary (œstrone), which controls the glycogen content of the vaginal mucous membrane. For this purpose, the oral administration of 1000 or 2000 I.U. of œstrone twice or thrice daily, or 0.5 mgm. of stilbœstrol, is usually sufficient: in obstinate cases the injection of more concentrated preparations may be necessary. This hormone is absorbed through the vaginal mucous membrane and may be administered in the form of vaginal pessaries or tampons. The treatment of chronic cervicitis is described on p. 912, but it has been shown that in such cases the secretion of the cervix forms a relatively small amount of the vaginal discharge. The bulk of the discharge is produced by the vaginal walls, and treatment of the cervical lesion should be supplemented by medicated vaginal pessaries and œstrone therapy.

Where there is general debility, one important object in the treatment is the improvement of the patient's general condition. The administration of vitamin A has been specially recommended. Patients who are required to wear vulcanite, rubber or celluloid pessaries should be instructed in the measures necessary to maintain local cleanliness.

Where erotic stimulation is responsible it may be very difficult to correct the patient's faulty tendencies. When no other causal lesion can be identified, improvement under hormone therapy suggests that the essential lesion in such cases is ovarian dysfunction. Estrone therapy is also helpful in the treatment of leucorrhœa in women in whom the menopause has occurred naturally or been produced by surgical or other therapeutic measures.

Parasitic Infections.—Special reference may be made here to the treatment of parasitic infections. The *trichomonas vaginalis* may prove very resistant because it only becomes pathogenic when the vaginal mucous membrane is already devitalised. The whole range of vaginal antiseptics has been employed in treatment. Mercurochrome and hexyl-resorcinol have been found useful, but at present the most popular remedies are picric acid or its silver salt and *arsenical preparations*. Picric acid may be employed in the form of medicated pessaries or by insufflation into the vagina as silver picrate powder. Arsenic may be used in the various tablets and medicated pessaries known as Devegan, Stovarsol, and Carbarsone.¹ Pessary treatment should be supplemented by the use of a vaginal douche of 1 in 500 lactic acid, either daily or every second day. Hormone therapy is added to improve the vitality of the vaginal mucous membrane. Good results have been reported from the use of vaginal pessaries containing lactose only. Treatment and observation may require to be continued for several weeks, the result being controlled by the examination of the discharge for the presence of the parasite. A clinical cure in the form of the arrest of the activity of the parasite can be secured in about 85 per cent. of cases.

In fungus infections, the best results are obtained by the daily application to the vaginal walls and vulva of a 2 per cent. aqueous solution of gentian violet, which, even in very dilute solution, is able to destroy the parasite. As the discharge diminishes the frequency of the application is reduced.

DYSMENORRHŒA

Dysmenorrhœa is the term applied to the various types of pain experienced by women at, or near, the times of the menstrual periods. Comparatively few women are absolutely without discomfort (p. 53), and some experience pain of a most prostrating type with each period. The whole subject of dysmenorrhœa is a very difficult one—the ætiology, in most cases, is very imperfectly understood, and consequently the treatment is often unsatisfactory. Dysmenorrhœa occurs in some patients who have an easily recognisable uterine or other pelvic lesion; an apparently similar lesion may be found in other women who have never had menstrual discomfort.

Clinical Types.—The clinical histories do admit of classification

¹ "The Extra Pharmacopœia," vol. i., p. 221. Martindale, 1941.

into certain types, but these types, unfortunately, do not correspond to definite pathological lesions. *While dysmenorrhœa may commence at puberty, a very much larger class of women do not experience menstrual pain until three or four years later.* In explanation of this experience it has been suggested that in many young women menstrual bleeding is for the first few years of the anovular type (p. 53), and that pain comes with the establishment of the secretory phase of the cycle.

Slight discomfort in the early years may give place to severe dysmenorrhœa by the age of thirty or thirty-five; a few women experience this difficulty for the first time in their thirties, and this is specially characteristic of cases in which certain types of fibroid tumour or pelvic endometriomata have developed. Many women who have suffered from dysmenorrhœa for several years find the symptoms relieved after marriage, and completely cured by the birth of the first child. In very few does pregnancy fail to relieve the discomfort, although there is the type in which dysmenorrhœa is first experienced after abortion or a full-time pregnancy. Some pathological condition resulting from the pregnancy, such as pelvic infection, tissue trauma or uterine displacement, is usually the cause in such cases.

The relationship of the pain to the phase of the menstrual flow varies widely. In the most characteristic form the pain comes on immediately before, together with or just after the appearance of the flow; it may last for from two to twenty-four hours. In this type the pain may be of a very severe nature, and where efficient treatment is not carried out, may extend in the course of time into the second day. In others there is a little pelvic discomfort for one or two days before, but actual pain does not begin until the onset of the flow; within twenty-four hours the pain may have gone completely, and the patient knows that she is free for another four weeks. In still another type, especially in cases where there is a pelvic inflammatory lesion, the patient suffers from increasing pelvic discomfort during the week before the onset of the period; this discomfort, which may not amount to severe pain, is relieved when the flow commences. In others the severity of the pain varies from stage to stage, but it remains constantly present for a few days before the onset, right through the whole period, and persists for a few days afterwards. In dysmenorrhœa, we are not concerned for the moment with the pelvic pain from which some women suffer in the intervals between their menstrual periods—this “half-time pain” is considered later in the chapter (p. 810).

There is a very wide *range in the actual symptoms* of the victims of dysmenorrhœa. The primary symptom is intermittent, cramp-like pain in the lower abdomen, coincident with, though sometimes just preceding, the menstrual flow, easily interpreted as due to severe muscular contractions. Before this active stage there may be a feeling of weight in the pelvis with backache, or a dull, dragging pain in one or both sides. When the active stage is exaggerated, the pain

may be described as extending down the front of the thighs, or appear to spread as spasmodic pains through the whole abdomen. In a few cases the pain may be so severe as to cause fainting or even collapse. There may be frequency of micturition, very rarely vesical tenesmus; habitual constipation may be interrupted by attacks of diarrhoea. Neuralgic sensations, particularly in the breasts, are often experienced; severe headaches, sometimes hemicranial in character, occur. The pelvic symptoms may be completely obscured by severe nausea, and even vomiting. While this wide extension of symptoms may appear to justify the description, "menstrual toxæmia," the importance of psychic factors in this type must be remembered.

In those patients in whom the menstrual discomforts are associated with the presence of some pelvic inflammatory lesion, neoplasm, or uterine displacement, complaints of backache, sacral pain, dragging pain in one or other side, and a sensation of weight or of "bearing-down" in the pelvis, precede the onset of the flow, but are usually relieved by it.

Ætiological Factors.—Attempts have also been made to classify types of dysmenorrhœa on an ætiological basis, but with indifferent success, as might be expected from our scanty knowledge of this subject. The terms *primary, essential or intrinsic dysmenorrhœa* have been used to describe cases in which we must seek for some inherent abnormality in the structure of the organs concerned with menstruation, or in the physiological processes connected with that function; the terms *secondary, acquired or extrinsic* have been applied to cases in which there is some acquired pathological lesion, such as a neoplasm, pelvic inflammatory condition or uterine displacement. Older classifications attached great importance to what was described as *obstructive dysmenorrhœa*—cases in which the escape of the menstrual discharge was believed to be impeded by an acute antifixion, or by an unusually narrow external os, the *pinhole os*. These conditions, however, may be present without dysmenorrhœa, and it is likely that such cases should have been included in the other large class of that nomenclature, namely, *spasmodic dysmenorrhœa*. What was described as *congestive dysmenorrhœa* is essentially the condition which we find in inflammatory pelvic lesions, neoplasms or displacements, where the premenstrual congestion is associated with considerable pain, which is usually relieved by the onset of the flow.

True dysmenorrhœa may be regarded as due essentially to the painful contractions of the muscle tissue of the uterine wall. The ischæmia resulting from such contractions may be a factor in the sensation of pain. The arrangement of the muscle layers of the wall, body and cervix, is extremely complex, the complexity being due to the course of development of the organ. There is ample evidence that the muscle fibres are very active at menstruation, which activity is associated with the oxytocic hormone of the posterior

lobe of the pituitary gland. The relationship of this hormone to the ovarian hormones during pregnancy has been described (p. 155): the follicular hormone sensitises the uterine muscle to its action, while the luteal hormone inhibits its action. In the menstrual cycle, the concentration of the follicular hormone in the circulation increases steadily up to the onset of the flow, whereas the luteal hormone appears in the second half of the cycle and disappears preceding the onset of the flow. It is possible that exaggerated activity of uterine muscle at the time of the period may be due to some hormonal irregularity more especially in the hormones of ovaries and pituitary gland. It may be noted that in *metropathia hæmorrhagica* (p. 788), where there is an overproduction of follicular hormone, there is no evidence of over-activity of uterine muscle. Overproduction of the luteal hormone may lead to abnormal thickness of the premenstrual endometrium, the separation of which may be difficult.

Abnormalities of Innervation.—Dysmenorrhœa may be associated with some disturbance of the innervation of the uterus, which receives its entire autonomic supply through the pre-sacral plexus (p. 40). The uterine nerves all pass through the paracervical ganglia, the ganglionic cells of which appear to be controlled by the follicular hormone of the ovary. After the removal of the ovaries, and before there is any noticeable change in the myometrium, the ganglionic cells shrink and the chromaffin cells disappear. Administration of œstrone produces complete regeneration of the ganglionic tissue, and this may be an important factor in œstrone therapy. Examination of the nerve tissue removed in pre-sacral neurectomy for dysmenorrhœa (p. 809) is reported to show evidence of neuritis. While the bladder and rectum also receive their sympathetic nerve supply through the pre-sacral plexus, they are stimulated by the pelvic visceral nerves. The uterine musculature shows evidence of a differential innervation in spite of the absence of a para-sympathetic nerve supply: disturbance in some group of the pre-sacral plexus coming from the bowel or bladder may produce spasmodic contractions of the uterus.

Abnormal Conditions of the Uterine Musculature.—Irregularities in the distribution, or in the course, of the muscle fibres may lead to painful contractions. In hypoplastic conditions of the uterus, such as the *uterus pubescens* (p. 99), irregular contractions may arise from the abnormally large amount of fibrous tissue which is interspersed among the muscle bundles. Defects in development, rather than an abnormal pelvic position, may account for the dysmenorrhœa sometimes associated with congenital retroflexion (p. 852). Similarly, irregularities in the muscle are probably present in cases of “*conical cervix*” and “*pinhole os*” (p. 104). In acute antelexion, also associated with what was formerly described as *obstructive dysmenorrhœa*, Blair Bell showed that at the point of flexion the concave anterior portion of the uterus has a poor and irregular distribution of muscle fibres, with an excess of

fibrous tissue. While some would deny to the possible stenosis in such cases any part in the causation of dysmenorrhœa, it may be that the poorly developed musculature is unable to drive the menstrual discharge past this obstruction—this would account for the fact that in cases of acute antelexion, dysmenorrhœa is most common where there is also definite hypoplasia. A similar factor may be present in those cases in which there is apparently a muscular spasm at the internal os—where, during operation, the sound or dilator encounters a very resistant ring or shelf at that level. Further, it must be borne in mind that the mucosa is most congested and swollen just before the actual menstrual discharge and may thus cause obstruction.

Certain types of acquired dysmenorrhœa may also be associated with irregularities in the distribution of muscle fibre. In the development of interstitial fibromyomata (p. 945), the course of the fibres is interfered with; and in subinvolution or chronic metritis (p. 925) the distribution of fibres is disturbed by an excessive amount of yellow elastic tissue.

Again, cases of acquired atresia of the cervix following injury at parturition, from cicatrization following amputation, repair or cauterisation of the cervix, or from radium therapy, may be associated with severe dysmenorrhœa, which may exist even when the orifice is not completely closed. There may be colicky pain, accompanied by inadequate or prolonged menstrual discharge.

Abnormalities of the Menstrual Discharge.—Normal menstrual discharge escapes from the uterus in a fluid form, and carries with it only small fragments of endometrial tissue. In some women each period is associated with the passage of clots; in many cases the clots are formed in the vagina, but in some the clot escapes from the uterus in that form. In the latter type, the patient may describe relief from pain, following the passage of a clot. In a few cases each period is associated with the passage of a *blood-cast of the uterine cavity* associated with extreme pain; the cast is dense and laminated, and contains fibrin, red blood corpuscles and leucocytes. Then again severe colicky pains may occur where the uterine cavity has become enlarged and distorted by the growth of fibroid tumours in the uterine wall: blood appears to be shed into the cavity more quickly than it can escape through the cervix, and each spasm is followed by a very free escape of blood.

The fragmentary nature of the endometrial tissue in the normal discharge has been referred to. One of the most obstinate and severe forms of dysmenorrhœa occurs in women who pass a membranous cast of the uterine cavity with each period—cases of *membranous dysmenorrhœa*. In such cases the superficial layer (*stratum compactum*) appears to be very resistant; the blood which normally escapes through that layer into the uterine cavity is shed laterally, and splits off the superficial layer completely. The cast varies in thickness; in young,

nulliparous women the membrane is thinner than that which is found in elderly parous women, in which latter cases it may be mistaken for the decidua from an early abortion. The casts are very seldom found intact, though they may occur rolled up and surrounded with blood-clot. The inner surface of the cast is perfectly smooth and pitted at the gland orifices; the outer surface is shaggy and has a considerable amount of fibrin adherent to it. On microscopic examination the epithelium of the endometrium is found intact on the inner surface, so also is the gland epithelium, but the stroma is infiltrated with blood corpuscles and serum. Under the epithelium and in the neighbourhood of the vessels a small number of enlarged stroma-cells may be seen, closely resembling decidua cells. The thicker casts contain a greater amount of the endometrium, and have more fibrin in their substance. There is no evidence to show that these casts are of infective origin. It may be necessary to differentiate these membranous casts from (a) uterine casts shed in cases of ectopic gestation, where the whole stroma is made up of decidua cells (p. 346); and from endometrium shed in cases of abortion, where there are abundant (b) decidua cells and also chorionic villi. Membranous dysmenorrhœa seldom occurs until a few years after puberty; a few women develop this condition after they have borne children. The patient may complain of a continuous gnawing pain while blood is being extravasated into the endometrium, followed by sharp colicky pains when the uterus is expelling the separated uterine cast.

Occasionally the uterine activity and congestion associated with menstruation disturb the position of a polypoid tumour, either of the mucous or fibroid type, and severe pain is associated with the attempt of the uterus to expel the polypus.

Gross Abnormalities. Neoplasms, Inflammatory Lesions and Uterine Displacements.—The importance of uterine hypoplasia as a cause of dysmenorrhœa has been referred to. In cases of cryptomenorrhœa, due to an imperforate hymen or abnormal septum (p. 775), there may be periodic uterine colic associated with the discharge of more secretion into the closed cavity. A similar condition is found where menstrual fluid is retained in the rudimentary horn of a *uterus bicornis* (p. 102). Again the severe dysmenorrhœa associated with endometriomata (p. 1016) is due to the increasing accumulation of secretion in closed cavities.

Neoplasms, other than interstitial fibromyomata and the type of endometrioma just referred to, lead, as a rule, to premenstrual congestion, relieved by the onset of the flow. Adenomyomata of the uterus (p. 975) are frequently associated with severe dysmenorrhœa. Similar symptoms are produced by inflammatory changes in the uterine wall, or by other inflammatory lesions of the adnexa, pelvic peritoneum or cellular tissue. This type of discomfort may also be associated with cases of appendicitis, especially where the tip of the appendix hangs over the pelvic brim.

Acquired uterine displacements, particularly of the backward and downward type, may be associated with some kinking of the blood-vessels which enter and leave the uterus at the level of the cervix. From this there may result some venous congestion associated with premenstrual discomfort; the persistence of pain with the actual flow may be due to chronic metritis (p. 923). In this type of lesion, too, it is remarkable that the same set of physical conditions in different patients is seldom associated with an equal degree of menstrual discomfort. In such cases it is well to confirm the cause of dysmenorrhœa by trying whether the correction of the retrodisplacement by the use of a pessary relieves it (p. 856).

Education, Temperament, General Health, Occupation, Environment, etc.—*Education* has played a considerable part in the development of dysmenorrhœa; fortunately a more enlightened attitude towards the education of girls is doing much to diminish its incidence. Formerly many girls grew up in a tradition and atmosphere of dysmenorrhœa—the very terms used to describe the menstrual periods were based on “illness.” Girls were encouraged to rest, and to consider themselves unfit for school, business, or social duties during their menstrual periods. There can be little wonder, therefore, that young women expected to have discomfort and pain; when the suggestion of pain was fully established, the certainty of its recurrence completed the tendency to habitual dysmenorrhœa. Reference will be made in the section on treatment to the educational and hygienic measures which now prevail.

Temperament is an important factor: the nervous, apprehensive, introspective type of woman is a more ready victim to dysmenorrhœa than her more even-minded sister. Such women may enjoy good general health and yet experience most intense suffering with each menstrual period. When they begin to anticipate the return of the attack of pain, anxiety and fear complete their mental and physical distress. In highly nervous women the dysmenorrhœa may be associated with unnatural sexual practices, which lead to pelvic congestion: in such cases hypertrophy of the labia minora is frequently present.

Women for whom menstruation was an almost unnoticed phenomenon may become acutely conscious of pelvic pain when their general health and vitality are impaired. With poor nutrition, physical or mental exhaustion, the menstrual periods become more and more troublesome.

Occupation and environment are very important. Dysmenorrhœa may appear for the first time after a girl has gone from her country home to the altered conditions of life and occupation which she requires to observe in a large city at business or study. The dysmenorrhœa may persist in her case, except during the periods of holiday which she spends in her own home. Sedentary occupations are often associated with dysmenorrhœa, though in such cases faulty hygiene may be the

chief factor. On the other hand, dysmenorrhœa is almost unknown among the healthy young women who carry on the heavy physical toil of farm life.

Endocrine Factors.—In some women dysmenorrhœa is associated with obesity or some other gross metabolic disturbance; in such cases the primary lesion may lie in abnormalities of thyroid or pituitary functions.

The part which irregularities in the secretion of the ovarian hormones may play in producing pathological activity of the uterine muscle at the onset of the menstrual flow has already been discussed.

Ovarian Dysmenorrhœa.—Cases have been reported in which dysmenorrhœa was found to be associated with thickening of the capsule of the ovaries, and relieved by plastic operations on the ovaries (p. 1124). It is difficult to find an exact ætiological relationship: many women in whom such ovarian lesions have been identified have never suffered from dysmenorrhœa.

Nasal Dysmenorrhœa.—Reference must be made to a peculiar type of dysmenorrhœa in which two areas in the nose, situated in the septum, the *genital spots*, become swollen and hypersensitive with each menstrual period. In such patients relief from dysmenorrhœa is reported to follow the application of cocaine or trichloroacetic acid to, or even cauterisation of, these spots.

The Principles underlying the Treatment of Dysmenorrhœa.—We have seen how uncertain is the ætiology of dysmenorrhœa and how many factors may be operative in its production. Actual pelvic examination may be of little assistance; it is difficult to understand why one girl should be practically incapacitated for about three days every month while another with apparently the same physique, the same mode of life, and, as would be found on examination, apparently similar reproductive organs, goes from one end of the year to the other with no disturbance.

PREVENTIVE TREATMENT.—Reference has been made to the importance of *education* as a factor in the incidence of dysmenorrhœa. During the past thirty years great progress has been made in the prevention of dysmenorrhœa by an enlightened policy in the education of girls, and the greatest progress has been made in girls' schools, particularly in boarding schools. The essential point in this policy is that girls are trained to disregard their menstrual period. Study, exercise, even daily baths are carried on without reference to the onset of periods, and in many schools the girls continue their games. Only in most exceptional circumstances is a girl allowed any relaxation of school routine because of difficulties associated with menstruation. In one group of schools, in which not only school routine but also vigorous games have been insisted on during the menstrual periods, it is claimed that over 90 per cent. of about 1200 girls remained free from menstrual discomfort up to the time of leaving school.

CURATIVE TREATMENT: *Primary Dysmenorrhœa.*—While the treatment of an individual case of primary dysmenorrhœa may in the end prove very difficult, the method of approach in all cases should follow a uniform line. In this condition general health and hygiene are of such prime importance that at a first consultation local pelvic examination is usually unnecessary. A careful investigation should be made into the clinical history—the age at which dysmenorrhœa appeared; the incidence, location, duration and apparent severity of the pain; the nature of the menstrual flow (scanty, profuse or associated with the passage of clots); and the associated discomforts which precede or accompany the severe pain. A further investigation should be made into the patient's general health, her diet, the arrangement of her meals, any tendency to constipation, her occupation, her interests beyond her daily duties, and, in particular, the amount and the type of physical exercise which she takes. During these investigations the personality of the patient will emerge—*e.g.* whether she is of the apprehensive, introspective type, prone to exaggerate and sympathise with her own discomforts. Such a clinical history usually gives wide scope for treatment on hygienic lines, without any reference to the pelvic organs themselves. An attempt to direct the patient's attitude and habits according to the principles referred to in the preventive treatment of dysmenorrhœa will very often be successful. Of special importance are rational meals, adequate time for meals, avoidance of constipation, and, particularly, regulated exercise. Such active games as tennis, badminton and even skipping-rope exercise may prove of more value than a multitude of drugs. A most useful set of exercises for patients of this type, even for women whose general debility or individual physical handicaps make vigorous games impossible, has been designed by Dr Sanderson Clow, and is published in the form of leaflets by H. K. Lewis & Co. Ltd., 136 Gower Street, London, W.C.1.

In cases where simple hygienic measures fail, especially in the very nervous patient who may have acquired the most excruciating discomfort with each period, further investigation and more active medication are required, a pelvic examination becomes advisable—this type of patient is usually convinced that she has a pelvic abnormality. It is better to make the examination under anæsthesia—without it a vaginal examination may be impossible, and even a rectal examination most unsatisfactory in such sensitive patients. At the same time, any appropriate minor surgical procedure of the types referred to later may be carried out. Where there is no evident abnormality of the pelvic organs calling for treatment, or justifying the employment of surgical measures, resort may have to be made to *sedative drugs*. Current views regarding the cause of menstrual pain indicate the use of such an antispasmodic drug as *atropin*. Administered orally in the form of $\frac{1}{120}$ to $\frac{1}{100}$ gr. three times daily, beginning two days or one day before the period is due, it may be

pushed until the early signs of atropin poisoning appear—viz., dryness of the mouth, flushing of the face, and some disturbance of accommodation. This drug has a selective action on smooth muscle fibre, and may prove successful in cases where many other drugs have failed. Some patients appear to find even greater comfort when the atropin is combined with 5 grains of aspirin or pyramidon. Another useful antispasmodic is ephedrine in $\frac{1}{2}$ -gr. doses taken at the onset of the pain and repeated if necessary. A similar specific action on smooth muscle fibre has been claimed for benzyl benzoate, administered in 20-grain doses in capsules every four hours, but this drug is not so often effective as atropin. Many years ago, Matthews Duncan recommended guaiacum in 10-grain doses thrice daily for a week before the onset of the period. A host of other vegetable drugs, such as hydrastis, viburnum prunifolium, cotton-root, apiol, and pulsatilla have been recommended for this condition, but their action is very uncertain. The almost universal household remedy—aspirin—is consumed in large quantities by many women. Antipyrin, phenacetin and such proprietary preparations as pyramidon, ammonal, compral, spasmalgin and liquor sedans are frequently employed. In nervous types bromides or sodium luminal may prove very satisfactory. The one drug in this array which appears to have a scientific basis for its employment is atropin. The others may have to be tried in turn until one is found to which the individual patient responds; even that drug may lose its effect in a few months. Patients will frequently be found to have explored the antispasmodic properties of alcohol and opium themselves, though fortunately the Dangerous Drugs Acts have made it very difficult for such women to obtain opiates without authority. Alcohol and morphia are most unsuitable drugs for such cases; the certainty of the recurrence of pain makes the drug habit almost inevitable. Codeine may be used in very severe cases, as being less likely to lead to a drug habit. It may be prescribed in $\frac{1}{2}$ -gr. doses by mouth at half-hourly intervals until relief is obtained (maximum of four doses) or in the form of Veganin tabloids. A similar, though less serious, objection may be urged against the whole group of analgesic drugs referred to above; they may relieve the pain temporarily, but they do not prevent its recurrence.

The other domestic remedies besides alcohol, usually taken in the form of brandy or gin, are rest in bed and the use of a hot-water bottle. Repeated hot fomentations usually prove more effective than dry heat. Radiant heat applied to the whole trunk may be helpful.

The treatment of dysmenorrhœa by ovarian hormones is now general. From its action as an inhibitor of the activity of uterine muscle during pregnancy, the luteal hormone, *progesterone*, would appear to be the one appropriate to this type of case. When progesterone is administered in the premenstrual phase of the cycle, the growth of decidual cells in the endometrium is stimulated and the

onset of the flow may be delayed : the fact that this hormone must be administered by injection makes it inconvenient for immediate use at the onset of the flow. The results recorded for the relief of pain by *progesterone* vary considerably, but in general these have been disappointing. The follicular hormone, *œstrone*, has been employed with greater, though still limited, success in cases of primary dysmenorrhœa. The effect of this hormone in stimulating development in cases of hypoplasia (p. 779), or its action on the cells of the paracervical ganglia (p. 801), may account for its success. It should be administered by the method already described for cases of amenorrhœa (p. 779) : 3000 I.U., or 1 mgm. of stilbœstrol, should be given orally, daily, throughout the cycle. Where a slight but incomplete response is secured by this method, 50,000 I.B.U. should be injected on five occasions, or 3 mgm. of stilbœstrol daily, during the latter half of the cycle. Treatment should be continued through two or three cycles.

We have seen that certain cases of primary dysmenorrhœa are relieved after marriage, and nearly all cured by pregnancy. In cases of sterility associated with dysmenorrhœa, any appropriate treatment which may improve the patient's chances of conception should be carried out (*vide* Sterility, p. 813 *et seq.*).

We now come to the *forms of surgical treatment*. The very nature of primary dysmenorrhœa indicates that there is little scope for heroic surgical procedures. Where there is no obvious abnormality in the reproductive organs, and even where there is an acute ante-flexion, a conical cervix, or a retroversion, the traditional surgical procedure has been dilatation of the cervix. Whatever justification remains for such treatment in the light of modern views on the cause of dysmenorrhœa, it has the merit of being very often successful. Case records show that about 30 to 40 per cent. of cases are cured by this operation and that about another 25 per cent. are improved ; of the "cured" cases, about one-fifth tend to relapse by the end of a year. This simple procedure is unlikely to succeed where severe dysmenorrhœa has been established for a long time or where the clinical picture deviates very far from that of true primary dysmenorrhœa. In this operation the cervical canal is simply dilated ; most surgeons take care not to force the dilatation beyond the point at which the cervical canal threatens to tear, while others maintain that a lasting result cannot be expected unless there has been definite tearing of the tissues enclosing the canal. The effect of the dilatation may be due to the circular musculature of the cervix being thrown out of action by overstretching, or possibly to the disruption of the sympathetic nerve fibres in the cervix by the same process. The operation must be conducted with a perfect aseptic technique. The usual method is steady dilatation with successive metal dilators up to the size of a No. 12 Hegar dilator. Where the cervix is particularly rigid and signs of tearing appear very early in the operation, an expanding sea-tangle

tent (p. 738) may be employed, to be removed at the end of twenty-four hours. The removal of the tent may be difficult and require the use of an anæsthetic again: the alternative course of waiting for another twenty-four hours allows the tent to be removed fairly easily, but there is a slight risk in damming up secretion and discharge in the uterine cavity by this tight plugging of the cervical canal. Many years ago Aschoff demonstrated inflammatory conditions in the adnexa following this type of operation. Curettage of the uterine cavity plays no part in the treatment of dysmenorrhœa, except that a test curettage (p. 118) shows a very thick endometrium. In such cases the very thickening of the endometrium may be a factor in the production of menstrual pain. In the hypoplastic uterus the endometrium is usually thin, and curettage may lead to a still less normal endometrium, showing extensive fibrosis.

In cases in which dilatation of the cervix proved unsuccessful, the next stage in surgical interference used to be incision of the cervix, laterally or antero-posteriorly, in many cases with division of the sphincter muscle at the level of the internal os. Where the cervix was elongated, plastic operations were designed to alter its form, particularly by shortening the posterior lip. Such operations are now seldom employed: the results were often unsatisfactory, and even in the successful cases, persistent leucorrhœa and other disturbing symptoms frequently followed.

Surgical treatment of the musculature of the cervix has now been largely replaced by treatment of the nerve supply of the uterus, based on recent progress in the relief of visceral pain by various operations on the sympathetic nervous system. It has even been suggested that the success of dilatation of the cervix depends on the disruption of the sympathetic fibres in that part of the uterus. A more specific method is the injection of alcohol into the base of the broad ligament with a view to blocking the nerves of the paracervical ganglia. Success by this method has been claimed in a large percentage of obstinate cases, but recurrence is common, and occasionally necrosis or local sepsis follows.

The most important recent contribution to the surgical treatment of dysmenorrhœa is the operation of *presacral neurectomy*, introduced by Cotte in 1923. The sympathetic nerves from the uterus, which are both motor and sensory, become grouped in their course into a median bundle, which is easily accessible as it lies in front of the fifth lumbar vertebra (p. 41). Section of this nerve should diminish the spasmodic contraction of uterine muscle, and also cut off the sensation of pain from that region. Cotte records success in all but two of 300 cases, but others have only secured success in 50 per cent. or less of their cases. This operation does not interfere with the essential functions of the uterus, as normal pregnancies and labours have been recorded in patients after the operation. This treatment should be

reserved for intractable cases in which there has been an exhaustive trial of other forms of treatment, and where the case is very definitely one of true primary dysmenorrhœa.

When dysmenorrhœa defied the lesser surgical measures already described, and where the degree of disablement was so great as to require radical treatment, an earlier generation of gynæcologists procured an artificial menopause by removing the ovaries. This deprivation of endocrine organs is now regarded with extreme disfavour, and where radical surgical measures are used, a much more satisfactory operation is the removal of the body of the uterus by supravaginal hysterectomy. With the development of radiotherapy it is now possible to arrest the periods by a much less disturbing process—namely, by the insertion of a suitably screened preparation of radium into the uterine cavity (p. 926). For this purpose radium is a more satisfactory mechanism than X-rays, which become effective by destroying ovarian tissue. While it is relatively easy to arrest the periods by an application of radium in a woman who is nearly forty years of age, much larger doses are necessary in younger women. Such procedures are, of course, only adopted with extreme reluctance, and only in cases in which the economic and social disabilities due to the severe dysmenorrhœa force such a step.

Cases of membranous dysmenorrhœa are among the most obstinate types. They may resist every form of medical and minor surgical treatment and require to be subjected to presacral neurectomy; or in extreme cases to radiotherapy for the production of an artificial menopause.

SECONDARY DYSMENORRHEA.—In cases of secondary dysmenorrhœa we regard the pain associated with menstruation as merely one of the symptoms of some organic pelvic lesion. The relief of this dysmenorrhœa will therefore depend on the appropriate treatment of the causal lesion, whether neoplasm, pelvic inflammatory condition or uterine displacement.

INTERMENSTRUAL PAIN

Cases are encountered occasionally in which attacks of pelvic discomfort, and even sharp pain, come on midway between the periods with very definite regularity. These attacks may last as long as two days, but they may be present for a few hours only. The pain is referred to one or other iliac fossa, and may be associated with nausea and vomiting. The condition has been named by German writers "Mittel-Schmerz" or "half-time pain." Generally it does not appear for several years after puberty; and it is more common in women who have borne children—it may follow a miscarriage. It is often, but not always, associated with dysmenorrhœa; there may be a slight watery or blood-stained vaginal discharge during the attack.

The ætiology of this condition is very obscure. It may be associated with changes in the Graafian follicles which, as we have seen (p. 56), are likely to be fully distended when the intermenstrual pain occurs—usually between the tenth and the fourteenth day of the cycle. It has been suggested that the pain may be associated with thickening of the *tunica albuginea*, or adhesions between the ovaries and surrounding tissues, which may interfere with the growth and expansion of the follicles. A more prolonged cramp-like pain occurring at this time is described as due to contractions of uterine muscle in a hypersensitive uterus. It is also found associated with interstitial fibromyomata, but the relationship of these tumours to this type of pain is certainly very obscure.

TREATMENT.—Treatment should be directed to the associated pelvic lesion if there is one. When there is no appreciable lesion the patient's general health should be investigated, and treatment by sedatives may require to be employed if the pain is very severe. Hormonal treatment has not been encouraging.

DYSpareunia

Sexual intercourse may be either prevented by the presence of some obstruction, or attended with varying degrees of pain. Both conditions have come to be included under the term *dyspareunia*. The pain following intercourse may persist for several hours, and is usually described as of a dull, aching character.

Primary Dyspareunia.—Congenital or development irregularities in the reproductive organs, associated with a narrow vaginal orifice or canal, or with an unusually complete or thickened hymen, may make coitus impossible. A similar impediment may result from over-development of the external genitalia in the male. Attempts at intercourse in such cases are associated with much pain, sometimes with trauma, and may result in *vaginismus*.

Secondary Dyspareunia.—Acquired dyspareunia may result from traumatic lesions, inflammatory lesions, or neoplasms. In the region of the vulva, ulceration of the recently torn hymen or other abrasions of the vaginal orifice, tender carunculæ myrtiformes, or small exquisitely tender deep red spots in the mucous membrane found about the same level, inflammatory conditions of Bartholin's glands, a urethral caruncle or an inflamed urethral orifice with its ring of bright red granulation tissue, are common causes of pain during intercourse. Solid or cystic tumours of the vulva or vagina may cause difficulties. Cicatricial contraction of the vulva or vagina following parturition is sometimes the cause; but a much more common cause is a degree of stenosis of the vaginal entrance or canal following a plastic operation for the repair of relaxed vaginal walls and a deficient perineum—a similar result may follow operations for the removal of neoplasms from the

vulva. Great constriction of vagina may follow radium therapy carried out for malignant disease of the cervix. An extreme form of stenosis occurs in older women in the form of *kraurosis vulvæ* (p. 888); but even the atrophy of the vulva and vagina after the menopause may be sufficient to cause dyspareunia.

In the upper portion of the vagina, hypertrophy of the cervix, associated as it very often is with inflammatory changes in the tissues, may be associated with tenderness on pressure, and therefore with pain during intercourse. More commonly the posterior fornix is tender on pressure, due to the presence in the pouch of Douglas of prolapsed ovaries, with or without the retroverted uterus, or to inflammatory lesions, such as chronic pelvic cellulitis or salpingo-oöphoritis. Adenomyomata, which develop in the recto-genital space (p. 958), or the presence of distended ovaries from endometriomata in the pouch of Douglas, give rise to dyspareunia (p. 1016). This symptom may be associated with ovarian cysts or uterine fibromyomata in the same position, but this pain is seldom so pronounced.

Functional Dyspareunia—Vaginismus.—In several of the conditions referred to above, especially in those in which there are sensitive lesions at the vaginal orifice, attempts at intercourse result in a most violent spasm of the constricting muscles of the vaginal entrance and even of the adductor muscles of the thighs. The spasm may even cause opisthotonos. In such cases either the actual pain on contact, or fear of the pain likely to occur on contact, produces this protective reaction, but there are many women in whom this violent muscle spasm takes place under the same circumstances, without there being any local condition to account for it. This condition is known as functional dyspareunia, or *vaginismus*. The cause is usually psychic—it may be the memory of an attempted violent defloration, or of the pain associated with a first attempt at intercourse: it may be due to personal aversion, or to an aversion to the whole process; it may be due to a dread of pregnancy and its alleged dangers; it may be the result of homo-sexual perversion.

Treatment.—In cases of primary dyspareunia adequate relief may be obtained in many cases by stretching the vaginal orifice under a local or a general anæsthetic; in some it is necessary to excise the tough hymen. Occasionally it is necessary to enlarge the vaginal orifice by a plastic operation, Chapter LV. After the operation a vaginal dilator should be used to keep the canal stretched. Ample time for complete healing should be allowed before intercourse is again attempted. Unfortunately, there are a few cases in which the degree of underdevelopment is so great that plastic operations of this type are of little value.

In the secondary types the causal lesions should be treated—*e.g.* it may be necessary to excise tender carunculæ myrtiformes.

Where all local lesions have been excluded, if necessary by

examination under general anæsthesia, we are left with the treatment of functional dyspareunia. In many cases the condition improves when complete intercourse has been effected on a few occasions. To secure intercourse on these early occasions a suppository containing either $\frac{1}{4}$ gr. of morphia or $\frac{1}{160}$ gr. hyoscine hydrobromide should be inserted into the rectum about half an hour before. In other cases where the patient herself is most anxious to overcome her disability, she may be taught to insert graduated vaginal dilators; this can most easily be done in a hot bath, the dilator being well lubricated with vaseline.

There are still cases of the psychic type in which local treatment is quite unsuccessful, and where the co-operation of a neurologist is necessary.

STERILITY¹

In the science of reproduction, sterility may be taken to mean failure to conceive, and in our study of the problems of sterility in women we employ the term in this more accurate sense. Unfortunately, some authors have given a wider interpretation, namely, inability on the part of a woman to bring forth a living and viable child. The wider sense includes, therefore, the various problems of abortion, premature birth, and intrauterine death, which have been studied in the earlier chapters of this book.

When a woman is incapable of being fertilised because of the complete absence, maldevelopment, destruction by neoplasms or by radiological treatment, or surgical removal of ovaries, uterus, or vagina, we describe her condition as *absolute sterility*.

Under the term *relative sterility* we include cases in which a woman, leading a normal marital life and possessing the essential organs of generation, fails to conceive. There may be an ascertainable lesion in the reproductive organs contributing to the sterility, but in many cases physical examination fails to detect an abnormality. The evident lesions may be of the minor type, such as slight stenosis of the vagina or acute ante flexion of the uterus, or of the major type, such as neoplasms or infections, distorting the reproductive organs. Some neoplasm or infective lesion associated with relative sterility may prove on investigation to have been a cause of absolute sterility. This term *relative sterility* is sometimes used in other senses; by some authors it is used to describe a patient in whom the birth of one healthy or at least viable child has been followed by persisting sterility—described also as “one-child sterility,” or more correctly as *acquired sterility*, and usually due to infection of the genital tract. Other authors apply the term to women who have had repeated abortions or premature labours, but never a live child; such a term is inaccurate

¹ For the revision of this section the authors desire to acknowledge the great assistance rendered by Mr V. B. Green-Armytage, F.R.C.O.G., etc.

when we restrict the term sterility to failure to conceive. Such variations in meaning must be remembered when the views and results of different authors are compared.

Fertility Rate.—Matthews Duncan showed from the Edinburgh and Glasgow Registers of eighty years ago that 15 per cent. of the marriages recorded were sterile. Since then there has been a progressive fall in the birth-rate for the whole country ; the rate of about 32 per 1000 for England and Wales in the eighties dropped to 14.1 per 1000 in 1940. This enormous fall is almost entirely due to the increasing practice of contraception, which has been responsible not only for what may be termed "Voluntary Sterility," but also for a great deal of *relative sterility*, in that many of the chemical and mechanical methods of contraception in common use are directly injurious to the delicate selective epithelium of the endocervix.

Moreover, recent investigations suggest that in many women full maturity of the uterus and genitalia depends upon the absorption by the vaginal mucous membrane of a growth hormone in the healthy human semen.

Therefore, anything or any method which prevents, retards or alters the normal degree of physiological absorption of human semen from the vagina carries with it during the early months and years of marriage the risk of future sterility from failure of uterine development and/or endocrinal asynchronisation.

The baneful influence and incidence of contraception makes it impossible to measure the degree of sterility and subfertility that actually exists to-day.

Male Sterility.—This reference to marriage indicates further that in dealing with cases of sterility we must consider the husband as well as the wife. Careful records of cases have shown that in at least 25 per cent. of sterile marriages the husband was incapable of procreation. Forsdike reported a series of 164 cases in which the seminal discharge of 15 per cent. of the husbands showed no spermatozoa, living or dead, on repeated examination ; in a further 10 per cent. there were only a few deformed and broken spermatozoa identified. Meaker states that in one-third of cases the male is responsible, in one-third the female is responsible, and in the remainder there is a joint responsibility. *In view of such figures, it is important that no disturbing form of investigation or treatment should be undertaken in a woman whose complaint is sterility until her husband has been efficiently examined.*

GENERAL CAUSES

There appear to be factors which it is impossible to identify : conception and a normal pregnancy may occur after sixteen to twenty years of sterile marriage without any treatment having been undertaken. For example, it is no uncommon experience to find that a

hitherto sterile woman conceives a few months after the adoption of an infant.

In general terms conception requires : (1) the production by the male of normal seminal fluid containing healthy spermatozoa, and the production and discharge of healthy ova from the surface of the ovary by the female ; (2) the deposit of the seminal fluid in the vagina¹ ; and the ascent of the spermatozoa through the uterine cavity to the Fallopian tube ; (3) the entrance of the mature ovum into and its passage along the Fallopian tube where fertilisation normally takes place ; (4) the passage of the fertilised ovum into the uterine cavity and its imbedding in the endometrium. The development of the ovum in that situation and its maintenance through the period of gestation have already been described (Chapter IV).

Sterility may result from any fault in the various processes recorded above, and in most cases it is possible to identify a definite lesion which may account for the failure in function. There are, however, a number of cases in which both parties are perfectly healthy, where even most careful examination fails to reveal any local lesion, and yet sterility remains absolute. It has been found now and then that both partners of such a sterile union have, with other partners, produced healthy children. This condition has been described as *selective sterility*.

Certain animal experiments have thrown an interesting light on such problems. It has been found possible by restriction of diet to breed animals with a low degree of fertility. Such animals, when mated with others of the same grade, prove sterile, but yet when mated with animals of high or even normal fertility, produce healthy young. Among human beings there are certain families with a tendency to low fertility, apart altogether from the question of elective sterility. When individuals from two such families are mated the union is likely to be sterile, whereas with other partners of normal or high fertility, healthy offspring may result.

Nutrition.—Recent studies in nutrition have shown that it is possible by a reduction in diet to reach a level at which the processes of growth are satisfied, but where reproduction is impaired ; in the female, œstrus is inhibited. When the diet is still further reduced to a point at which growth is impaired, ovulation disappears—the sexual inhibition varies with the degree of starvation. In these experiments, fat has proved to be more important than carbohydrate for the maintenance of fertility. The rôle of the vitamins has also been investigated : deprivation of vitamin A retards ovulation in

¹ Penetration of the phallus into the vagina is not essential. Cases have been recorded in which semen discharged on the vulva has resulted in a pregnancy. Two of the authors (Munro Kerr and Hendry) examined together a young woman (two to three months pregnant) who had a completely imperforate hymen. It was possible to pass a probe into the vagina through a small opening on the posterior wall of the urethra just within the external meatus. Through this opening spermatozoa passed into the vagina and found their way to the uterine cavity and probably to the Fallopian tube, where fertilisation of the shed ovum took place.

growing animals, but even in adults the loss of vitamin B arrests ovulation before general nutrition is affected. Vitamin C (anti-scorbutic) is seldom entirely absent from the diet, and only a small amount seems necessary to maintain fertility. The specific action of vitamin E is on reproduction; but, so far as the female sex is concerned, it may be described as an anti-abortive, rather than an anti-sterility vitamin. The absence of vitamin E in male rats leads to the entire disappearance of the seminiferous tubules, but in females there is either abortion or "resorption" of the embryos about fourteen days after fertilisation. While a minimal amount of vitamin E is necessary for reproduction, further feeding with this vitamin does not increase the fertility—the numbers in and the weight of litters are not increased. Vitamin E is so widely distributed that it is difficult to imagine an ordinary diet used by human beings which does not contain a sufficient amount. Such value as it may have in women is in the prevention of abortion (p. 334).

Age.—Certain other general conditions tend to be associated with sterility. Matthews Duncan considered age an important factor: he believed that in women the period of maximum fertility was from 20 to 25, with a slow decline up to the age of 35, and a more rapid fall to 45, after which births are very rare. Calculated in the same way for men, the period of maximum fertility appears to be from 20 to 30, with a slow decline to 40, and a more rapid fall thereafter. The power of procreation, however, is retained much longer by men than by women, and has been demonstrated up to the ages of 70 and 75. Matthews Duncan showed further that the average interval between marriage and the birth of a first child was seventeen months. It is reasonable, therefore, to regard every woman who fails to conceive within twelve months from marriage as relatively sterile.

Other General Causes.—Sterility appears in about 33 per cent. of consanguineous marriages, as compared with the normal sterility rate of 15 per cent. It occurs too when individuals of widely different races are mated—octoroons, who represent repeated mingling in three generations of whites and negroes, are usually sterile.

General debility associated with such diseases as tuberculosis, diabetes, etc., may be associated with sterility. Obesity, whether due to some fault in metabolism or to a definite endocrine deficiency, is similarly associated.

Any disorder of the endocrine system predisposes to sterility. It is well to remember that due to some dyscrasia of the pituitary some 30 per cent. of women have normally and periodically anovular menstruation, though it has been proven by repeated biopsies that not more than 5 per cent. of these women are permanently and habitually anovular. It has been found that in many sterile women the basal metabolic rate is below the normal standard. Many women believe that their failure to conceive is due to want of sexual feeling

on their part, even during actual intercourse ; while the majority of sterile women make this complaint, there are many women who conceive repeatedly, without ever experiencing any sexual response. It is difficult in the present state of our knowledge to account for this incomplete endowment. Alcoholism and addiction to drugs may be factors in the production of sterility. An occasional cause is personal ignorance—not infrequently patients display amazing ignorance of the whole process of sexual relationships.

LOCAL CAUSES

Vulva and Vagina.—The chief lesions in the vulva and vagina likely to be associated with sterility are those which prevent normal sexual intercourse ; it must be remembered, however, that there are cases in which fertilisation has occurred without penetration (p. 815). Disabling lesions have already been described in the previous section as causes of dyspareunia, including that functional disability vaginismus (p. 812). But yet another cause of primary sterility may not infrequently be discovered, namely “tenting” of the vagina—here the vault of the vagina is definitely narrowed and constricted, the cervix being felt like a small acorn projecting into an encircling ring. This condition, due to a developmental error, is often associated with certain android features in the patient and in her pelvis.

The variations in the quality and quantity of vaginal secretion have been described (p. 792). The normal secretion is acid in reaction with a hydrogen-ion concentration of 4.5 to 5, equal to 0.5 per cent. lactic acid. The seminal fluid is alkaline in reaction, and the spermatozoa can only maintain their rapid movements so long as they are kept at a suitable temperature, and in a suitable alkaline medium. Even the normal acid vaginal secretion destroys the spermatozoa very quickly, and they are seldom found motile in the vagina more than two hours after intercourse. Where the acidity of the secretion is above normal, it may be reduced by alkaline douches, but the limits of functional variation in the reaction are very narrow.

Many women attribute their functional defect to their inability to retain the seminal fluid ; the escape may be due to a congenital deformity, a hypoplasia of the vagina with a very short canal, or to a deficient perineum with eversion of the lower vaginal walls ; but it has also been described as due in certain cases to a very vigorous muscular reaction associated with the sexual orgasm. The condition is described as *profluvium seminis*, and the patient may experience a greater feeling of security by resting on her back for some time after intercourse, with her buttocks well raised on a hard bolster. As just stated, the life of the spermatozoa in the vagina is very short, the above factor may therefore be an important one—the amount of male secretion actually required for fertilisation being small.

The Cervix.—Stenosis of the cervical canal was almost the traditional cause of sterility in women up to a few years ago. This belief could hardly be supported on mechanical grounds, as the cervix which allows the escape of menstrual blood is more than wide enough for the ascent of the spermatozoon. The justification for the belief, however, lies in the fact that a large percentage of cures, even as high as 33 per cent., has been reported in cases in which the only treatment employed has been simple dilatation of the cervix. It may be that in cases in which the cervical canal is long and narrow, the dilatation may ensure the removal of inspissated mucus which has accumulated in the canal and made the ascent of the spermatozoa difficult.

Chemical contraceptives, especially if employed inside a rubber cap, or those types which are inserted into the uterus injure the delicate ciliated epithelium of the arbor vitæ. The resulting irritation and low-grade inflammation at first tends to produce an opaque and sticky cervical mucous plug which throughout the intermenstrual cycle may completely prevent all passage of the spermatozoa; later, an erosion of the external os appears, due to the low-grade inflammation of the endocervix spreading downwards (p. 907). Admittedly an erosion is to be seen at times in the virgin, but in such cases it is due to a hold up of the squamous cell epithelisation at the orifice of the cervix. In the type of erosion which is seen due to introduced sepsis, organisms, leucocytes and débris can easily be demonstrated. Indeed it has been said of this type of erosion that it is the outward and visible sign of an inward and invisible endocervicitis. From the point of view of sterility it is imperative to diagnose, prevent or treat such conditions (*vide* treatment of erosion, p. 913).

Where the cervix is unusually long, as in some congenital abnormalities, the external os may protrude farther down the vagina than the pool of seminal fluid deposited in the posterior fornix. Where the cervix is inconspicuous, and where the external os is level with the vaginal vault, either from hypoplasia or following an amputation of the cervix, the cervix may be above the seminal pool. Where the cervix is directed towards the anterior vaginal wall, as in cases of retroversion and in some cases of acute antelexion, the seminal fluid may not reach the external os.

Laceration of the cervix may play an important part in the causation of acquired sterility, though many women have repeated pregnancies in the presence of extensive cervical tears. These lacerations are frequently associated with endocervicitis and excessive vaginal discharge. The possible reaction of the spermatozoa to such abnormal vaginal secretions has already been referred to (p. 817). When lacerations are treated for the relief of sterility, cauterisation of the infected areas with the electro-cautery is usually better treatment than amputation. Even when the physical result of the amputation appears satisfactory, the endocervix may have been so altered as to upset the

passage of the spermatozoon. Atresia of the cervix, following parturition or operation, though rarely a cause of sterility would of course call for urgent attention because of interference with menstruation (hæmatometra and possibly pyometra).

Polypi of the cervix, usually resulting from infection and overgrowth of granulation tissue, should be removed by the electro-cautery.

The Body of the Uterus.—A more accurate knowledge of the physiology and pathology of the endometrium has largely displaced *endometritis* as a cause of sterility. The most important endometrial irregularity is the incomplete menstrual cycle associated with anovular menstruation (p. 53); in such cases examination of the endometrium removed about five or six days before the period shows no evidence of the secretory phase, and indicates the absence of an active corpus luteum in the ovary. There are certainly a few cases in which hypertrophy of the endometrium, with even polypoid growth, may be associated with sterility, but it also causes such profuse menstrual bleeding as to require treatment on that account. The operation of curettage plays little part in the treatment of sterility, except very occasionally as a diagnostic measure (p. 118); in fact, such an operation, carried out in the treatment of incomplete abortion, appears in some cases to have been the starting-point of acquired sterility, probably from the introduction of a low-grade infection to the isthmal or interstitial portions of the tubes. Much more important than the endometrium in the ætiology of sterility is the general development of the uterus.

Hypoplasia or immaturity of the uterus is usually associated with late onset and/or irregularity of the menstrual periods together with dysmenorrhœa—sterility but completing the clinical picture.

Uterine displacements are of some importance. The relationship of acute ante flexion to sterility depends not so much upon the flexion, or possible stenosis of the cervix, as upon the degree of hypoplasia of the body of the uterus, so often associated with this congenital deformity (p. 860). Where the body of the uterus is well developed, dilatation of the cervix may secure the desired result. In cases of congenital retroversion the degree of development of the uterus is also of prime importance.

There is ample clinical evidence that retrodisplacement is a cause of sterility. Many patients have been able to conceive following the correction of such a displacement, and the maintenance of the uterus in anteversion by a vulcanite pessary or a suspension operation. With the body lying in the pouch of Douglas the cervix lies along the axis of the vagina, or against the anterior wall, and is directed away from the *receptaculum seminis* in the posterior fornix. A most interesting factor in such cases has emerged from the tests for patency of the Fallopian tubes described later in this section. In many cases the tubes do not allow the passage of air so long as the fundus lies in retroversion or retro-

flexion—the tubes being mechanically occluded ; when the displacement is corrected, air passes freely through the tubes. These observations apply only to cases of mobile backward displacement, congenital or acquired ; in cases of fixed retroversion, sterility is probably due to the inflammatory lesions of tubes, ovaries and pelvic peritoneum, so often associated with this condition.

Prolapse of the uterus, even when the cervix comes down to the vulva in the erect posture, has extraordinarily little effect on continued fertility.

There is an important relationship between fibroid tumours of the uterus and sterility : one estimate gives the incidence of sterility in women with fibroid tumours as 30 per cent. Some clinicians have suggested that these neoplasms develop because the woman has failed to conceive. Fibroids as a cause of sterility have usually to be considered in women over thirty or thirty-five years of age, already beyond the optimum age for fertility. The functional disturbance produced by a fibroid tumour depends on the extent to which the neoplasm distorts the uterine cavity, or interferes with the vascularity and nutrition of the endometrium. It would appear that sterility is most frequent in the submucous type of fibroid, or where the tumour produces distortion of the course of the Fallopian tubes or of the uterine cavity ; the relationship of such tumours to abortion has already been referred to (p. 323). Another factor in the relationship of fibroids to sterility is the frequent association of such tumours with low grade chronic inflammatory changes in the Fallopian tubes, and with cystic or endometriomatous changes in the ovaries. In cases in which fibroids are associated with sterility, the operation of myomectomy is well justified, not only in the hope that it may allow conception and prevent abortion or dystocia but also as sound treatment for the neoplasm itself. There are many records of fertility established by such treatment.

Fallopian Tubes.—Lesions of the Fallopian tubes have always been recognised as potent factors in female sterility, and were believed to account for about 16 per cent. of such cases. With the means formerly available, only those cases in which a palpable lesion of the tubes could be identified on bimanual examination, or a less bulky lesion observed later at an abdominal operation could be included. The method of tubal insufflation with gas, introduced by Rubin in 1920, has allowed a complete revision of those statistics ; this method has identified complete tubal occlusion in about 29 per cent. of all cases seeking advice. But in only 14 per cent. of patients with primary sterility are the tubes found to be blocked. The method has also demonstrated that the tubes may be partially occluded in the phase of extreme congestion preceding each menstrual period, and that tubal occlusion associated with backward displacement of the uterus may be mechanical and due to the malposition of the uterus.

Congenital lesions account for a very small proportion of cases of tubal sterility; the malformation may amount to complete absence, a persistence of the spiral convolutions characteristic of infancy or defective development of the fimbriæ. Such lesions cause absolute sterility.

The most frequent and important lesions of the tubes, associated with sterility, are inflammatory. Gonorrhœal infection is the most common cause. It produces great destruction by involving the mucous membrane—obstructive adhesions form between its folds, closing one or both ends of the tubes (p. 1028); usually both sides are affected. Tuberculous lesions are equally destructive, but much less frequent. Puerperal infection, especially following abortion, is an important source of acquired sterility, but the effect on the tube may be much less marked than in gonorrhœal lesions, although in the graver forms of puerperal infection the tubes may sustain great damage. In milder puerperal infections there may be little or no injury to the mucous membrane, as the infection travels through the cellular tissue and gives rise to a perisalpingitis with subsequent angulation or stricture of one or both tubes. In some the occlusion may be entirely confined to the abdominal ostium at the fimbriated end. In others the block is only at the uterine ostium and in the interstitial portion of the tube, the remaining distal portions being quite normal and healthy. Lesions of these types are worth considering from the point of view of plastic surgery, for salpingostomy or tubo-uterine implantation has a success rate of 20 to 30 per cent., the ratio varying with the experience of the operator in this class of work. On the other hand, if the tubes are occluded in the isthmal portion or the history suggests that gonorrhœa is the cause of the block, the chances of success are minimal.

Inflammatory lesions associated with *appendicitis* are usually of the perisalpingeal or fimbrial type, unilateral, and cause comparatively little damage to the mucous membrane: such lesions may be very favourable for plastic surgery. Pelvic adhesions may occur after any inflammatory or tubercular condition of the upper or lower abdomen. These tend to surround the tubes and ovaries with delicate veils of peritoneum, occlude the fimbrial ostia and bind the uterus to the peritoneum of the posterior pelvic wall. Such cases of sterility are eminently suitable for restorative surgery.

Neoplasms of the tubes are rare, but the lumen may be distorted by ovarian (especially intra-ligamentous) or uterine tumours. The interstitial part of the tubes may become obliterated by abnormal endometrial proliferation, and in *salpingitis isthmica nodosa* the isthmal portion is usually occluded (p. 1032).

Investigation of Tubal Patency.—In 1920 Rubin introduced his method of testing the patency of the Fallopian tubes by allowing carbon dioxide gas under pressure to escape into the abdominal cavity

by means of a cannula introduced into the uterine cavity. To-day there are several methods of insufflation ; some use the Co_2 apparatus of Provis ; others the ingenious and accurately recording instruments devised by Rubin or Bonnet or Marbach. On the other hand many people, unless they are running a large sterility clinic, prefer to use air, the pressure of which is recorded on a simple blood-pressure gauge. The apparatus, whether it is that of Douay (Fig. 322), or one with a cannula attached to a Higginson syringe and dial, is cheap, handy and answers most purposes ; by that is meant, it will inform the operator whether or not both tubes are patent and at what pressure. Should normal patency exist the therapeutic value of such a procedure is about

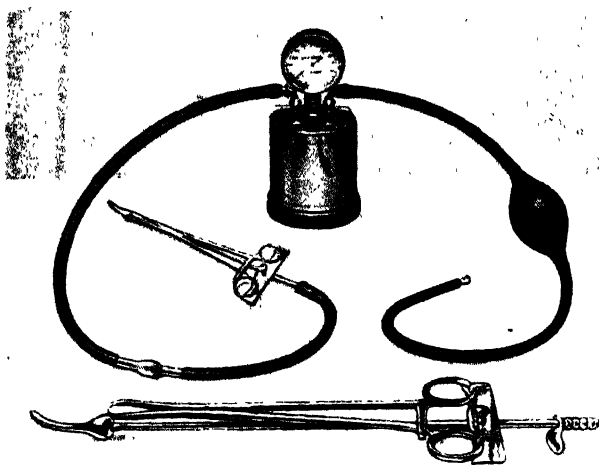


FIG. 322.—Insufflation Apparatus. (Allen & Hanburys.)

15 per cent. Insufflation may be done under morphia and atropin in the consulting room, but most often, and preferably, it is performed under general anæsthesia as a part of the operation of dilatation for dysmenorrhœa and/or sterility.

However performed certain rigorous precautions must be observed before insufflation ; for instance previous examination should have determined the presence of any tubo uterine inflammation or tenderness. There should be no purulent cervical discharge nor should there be any menstrual or uterine bleeding at that time. The best time to determine patency of the tubes by insufflation is the first week following complete cessation of menstruation.

When one tube only is patent, the pressure necessary before the passage of gas may rise up to 100 to 120 mm., and the sound of escaping gas or air can be heard over one iliac fossa only. If the investigation is being conducted under anæsthesia, it is not advisable to allow the pressure to rise above 200 mm., as the patient cannot indicate by

her sensation of pain that closed tubes, possibly with atrophied walls, are becoming dangerously stretched by the pressure. If the patient is not anaesthetised, her experience of pain as a guide to intratubal pressure may allow the pressure to be raised up to 250 or even 300 mm. The maintenance of such a pressure, together with the absence of any sound of escaping gas or air, indicates almost certainly complete occlusion of both tubes. Rubin claims that he is able to diagnose the seat of tubal obstruction from the patient's description of the site of the pain; but there are few gynaecologists who are prepared from their own experiences to allow such accuracy to the method.

Occasionally the pressure may rise to quite a high figure—160 to 180 mm.—and then drop quite suddenly to 60 to 80 mm., continuing at that level with a steady escape sound inside the abdomen. Provided accidental leakage can be eliminated, this indicates that some obstructing adhesions have been overcome or that a plug of mucus has become displaced. Rhythmic peristaltic movements of the tubes have been demonstrated in fresh operation specimens, and corroborated by kymograph tracings taken during tubal insufflation; abnormalities of this tubal activity have been suggested as further possible causes of sterility. Tubal spasm at the isthmus can be similarly demonstrated by using the apparatus of Bonnet or Rubin.

In Rubin's original observations he based his complete positive results not only on the pressures recorded by the manometer and the sound of the gas escaping into the abdomen, but also on the establishment of a pneumoperitoneum as demonstrated by radiological examination. The patient is photographed as soon as she rises from the table, and a subphrenic pneumoperitoneum can be demonstrated on one or both sides. This confirmation may be advisable in stout patients in whom the sound of escaping gas is obscured, but is seldom necessary in the presence of the other positive signs.

The presence of free gas or air in the peritoneal cavity may give rise to slight discomfort, particularly pain in the chest and shoulders; sensitive patients may complain of faintness and sickness, usually relieved by lying down. These discomforts can be obviated by using small amounts, *i.e.*, by stopping the test as soon as ever positive signs are elicited. There is less trouble with this complication when carbon dioxide gas is used than in the forms of test apparatus in which air is employed; the carbon dioxide is more quickly absorbed by the peritoneum. The test may cause slight uterine bleeding for one or two days, but this appears to be of little importance. When Rubin's test is employed according to the principles indicated, with respect not only to the details of the procedure but also to the condition of the patient, it appears to be a reasonably safe method.

Employed originally as a diagnostic method, Rubin's procedure has been found to have a therapeutic value. Rubin himself found that among the women whom he had investigated, conception occurred in

about 15 per cent., in whom there had been no other treatment. While the slight dilatation of the cervical canal may have been a factor, it is probable that the gas pressure may have freed some adhesions or displaced some mucus, as has been referred to above. For this reason we recommend that insufflation be repeated two or three times, in the hope that a therapeutic result may be obtained : in such repeat



FIG. 323.—Showing a Normal Uterus and Markedly Spiral Tubes in a Case of One Child Sterility.



FIG. 324.—The same Patient showing "Feathering" of Lipiodol over the Pelvis—24 hours later.



FIG. 325.—Showing Occlusion at the Fimbrial End of Both Tubes subsequent to Low Grade Puerperal Infection.



FIG. 326.—Showing the Rounded Cornua of Total Occlusion subsequent to Criminally Induced Abortion.

insufflations it may be possible to avoid tubal spasm by giving the patient morphia or atropin half an hour before the operation.

Lipiodol.—Gas or air insufflation is a very satisfactory way of demonstrating the patency or occlusion of the tubes, but except in the opinion of a few authorities it does not give precise information regarding the position or extent of occlusion in tubes which are closed, or the prospects of improvement by surgical measures. For this purpose another method has been introduced—the injection of the

tubes with opaque fluids which will give a shadow on a radiograph. In Rubin's earlier experiments he used fluid media, but found them irritating to the peritoneum. Following the employment of lipiodol (a non-irritating 40 per cent. solution of iodine in poppy-seed oil) the therapeutic results have been almost treble those of insufflation. Such results may be due to the iodine acting as a germicide upon the mucous membrane of the uterus and Fallopian tubes, or possibly the lipiodol has a stimulative action upon the ciliary mucous membrane and the white tunic of the ovary. Some maintain that it breaks down sticky adhesions and thereby reawakens rhythmic movement of the Fallopian tubes which can transmit the ovum from the fimbriæ to the isthmus. Whatever the action, if the oil be injected with the usual precautions shortly after cessation of the menstrual period conception frequently occurs within three months. Moreover, quite apart from its therapeutic value is the vital importance of knowing and being able to demonstrate on a film the ability of a woman to conceive after a

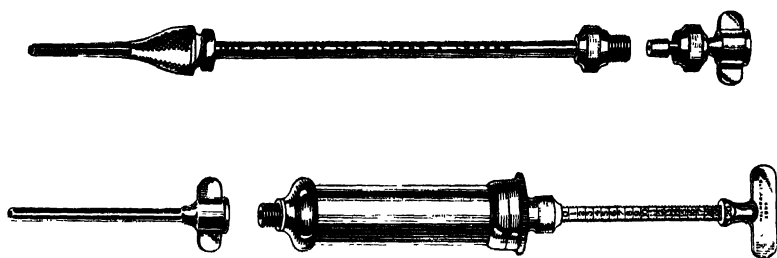


FIG. 327.—Syringes. (Thackray.)

septic labour or miscarriage, criminal abortion, fulminating appendicitis, extrauterine gestation and the like. Such problems frequently present themselves, and it is only upon the evidence of a hystero-salpingogram that an opinion can be arrived at or the strategy and tactics of any surgical procedure properly be planned.

The technique is simple. The patient who has previously been examined is asked to meet the gynæcologist in a hospital X-ray Department or the consulting room of a radiologist. She is placed upon the X-ray table in the dorsal position with the buttocks raised on a sand-bag. One limb of a Barnes speculum being inserted, the cervix is grasped by a volsella and painted with dettol or iodine. The nozzle of the syringe (Fig. 327) is introduced and held taut against the cervix and the sand-bag is removed.

A fluoroscopic screen is then placed upon the abdomen and the lights are switched off. The warmed lipiodol or viscous neo-hydriol is then injected and watched on the fluorescent screen passing from the uterus to the tubes and gently spilling (after 5 or 6 c.c. as a rule) into the peritoneal cavity. At the right moment, when a satisfactory picture is featured, the X-ray film is taken. If the position of the

uterus is backwards she is then turned on her side and another film taken.

Anæsthetics are never necessary and are indeed better avoided. If the patient is nervous or one suspects from previous examination that she may be spasmophilic, she can be given beforehand $\frac{1}{100}$ gr. of atropin and/or $\frac{1}{4}$ gr. morphia. In Out-Patient Departments, where 6 or 7 patients are filmed one after another, no injections are needed.

If there is any question as to a proper peritoneal spill, or doubt regarding the patency of the tube or tubes, it is always advisable to ask the patient to attend for a straight film picture twenty-four hours later, in which case the oil will be seen "feathering" over the pelvic cavity (Fig. 324), whereas if there is a block as in Figs. 325 and 326 the distal end of the tube will be clubbed both before and after the control picture. Occasionally filling defects may be seen on the film indicative of submucous fibroids. With due care there are very few complications. In a series of 2500 salpingograms there was no case of infection or catastrophe. There were, however, two cases of oil embolism which beyond causing temporary pallor and sickness were of no consequence. In both of these the oil was injected too soon (day following) after a menstrual period.

It often happens that cases negative to CO_2 or air are found to be positive to oil, that is, the oil readily spills into the peritoneal cavity; the reason for this is that the warm oil does not or is not so likely to cause spasm of the tubes in the interstitial portion. If the tubes are occluded at the internal ostia it will seem that the cornua are rounded (Fig. 326); whereas if only spasm exists the appearance is pointed.

If the block is at the fimbrial ends or in the ampullæ, the prognosis for salpingostomy is relatively good, but should the interstitial portion be occluded and the history be that of criminal abortion, it will very frequently be discovered at operation that the distal portion of the tube is patent and normal (a thing practically never found where there has been a history or suspicion of gonorrhœa).

In such a case tubo-uterine implantation (Fig. 328), which has a success rate of about 20 per cent., is worth consideration, but if the tubes are occluded in the isthmial portion, results are disappointing, for even though the canal can be opened and threaded, it shortly after closes again; furthermore with the patent distal portion of the tube implanted into the uterus there is hardly sufficient tube left to function normally (*vide* Chapter LIX).

Ovaries.—The place of ovarian lesions in sterility is more difficult to assess and impossible to demonstrate. Defective development of these organs is usually associated with evidence of endocrine deficiency, including infrequent or scanty menstruation; the uterus also in such cases usually shows underdevelopment. The possibility of stimulating

the organs to more complete development has been referred to (p. 778). In cases associated with *anovular* menstruation (p. 53) the essential fault is hypofunction of the pituitary, and an attempt may be made to stimulate the Graafian follicles to complete development by the administration of the gonadotropic hormone of the anterior pituitary lobe (p. 778) or the serum of pregnant mares (gestyl).

Ovarian sterility may also be acquired as a result of inflammatory processes, neoplasms or other factors. The commonest cause in this group is a pelvic peritonitis, imbedding the ovary in adhesions, producing great hypertrophy of the capsule, and preventing the shedding of ova. The ovary may also be involved in abscess formation



FIG. 328

The Typical Dog's Ear appearance of a Spasmodic Occlusion at both Cornua. This patient, four years married, conceived the following month.

Showing the lines of both tubes which, after excision of the proximal blocked (cornual) portions, have been threaded with silver wire and implanted into the Uterus. They are removed in two months. (*Vide* plastic operations on Fallopian tubes, Chapter LIX).

(p. 1043). Among tumours, corpus luteum cysts are usually associated with sterility; ovarian endometriomata, going on to the formation of chocolate cysts, produce sterility, but in such cases operative interference, with careful excision of the new growth from the rest of the ovarian tissue, may secure fertility. Ovarian and parovarian tumours may produce sterility by splitting the layers of the broad ligament and compressing the lumen of the tube. The treatment of ovarian neoplasms is certainly surgical, and conservative methods must be pressed to their utmost to secure fertility. The decapsulation of the ovary with a thickened *tunica albuginea* is not likely to meet with success.

Pelvic Peritoneum.—The importance of pelvic peritonitis in the causation of sterility has been referred to. The adhesions persisting from such a lesion, whether originating from an intestinal inflammatory process, a tuberculous process, or from the reproductive organs them-

selves, may seal off the ends of the Fallopian tubes, bury the ovaries in a mass of adhesions, and retain the uterus in retroversion. In only a few cases is it likely that fertility will be secured by the surgical treatment of such extensive lesions.

The Investigation and Treatment of an Individual Case of Sterility.—

The investigation of a case of sterility should begin with a careful assessment of the woman's general condition. Inanition and obesity are equally important: the former may indicate some wasting disease, such as diabetes or tuberculosis, the latter some metabolic or endocrine disturbance incompatible with pregnancy. Reference has been made to the fact that in many sterile women the basal metabolic rate is low, though there may be no other sign of thyroid insufficiency. For this reason we consider that thyroid therapy, 1 to 3 grains a day for twenty-five days in every month, is essential for at least three months, and combined with this treatment the patient should take three capsules of halibut oil a day and five drops of Lugol's iodine in milk. Previous illnesses and operations should be inquired into, *e.g.*, an attack of suppurative appendicitis in adolescence may have prejudiced the patient's prospects of pregnancy. The patient's habits regarding dietary and exercise may be important. At this stage inquiry may be made regarding fertility in the patient's family.

Her menstrual history requires special consideration. Delayed puberty or scanty and painful menstruation may indicate hypofunction or hypoplasia of the reproductive organs or of their controlling endocrine glands. Excessive menstruation requires investigation as a clinical problem apart from sterility. Excessive leucorrhœal discharge may indicate some organic lesion. Should the patient have had a previous pregnancy or pregnancies, the history of each pregnancy, its termination in abortion or full-term labour, operative interference, if any, and the nature of the convalescence should be noted. Finally, inquiry should be made regarding marital relationships.

This interrogation should be followed by a detailed examination of the patient. Note should be made of any abnormality in the secondary sex characteristics. During the examination of the pelvis some definite lesion may be found, but very often the reproductive organs are found to be perfectly normal.

Whatever be the findings, no further steps should be taken until the husband's condition has been assessed with equal detail. This investigation should include an examination of a (*chemical free*) condom specimen of the seminal discharge, carried out within an hour of its being secured and kept at a low temperature until examined: the number and motility of the spermatozoa, the frequency of dead spermatozoa and of abnormal forms should be estimated. Hitherto much stress has been laid upon the postcoital test of Hühner which depends upon the discovery of live or motile sperms in the cervical canal for a matter of hours after cohabitation. If such spermatozoa were found

then the husband was deemed fertile, but if they were absent then the man was indicted. But since it has been shown that the penetrability of the cervical mucous plug is subject to cyclic variations which depend upon the oestrogen level of the blood it may quite well happen that a Hühner test will be found positive on certain days of the cycle and negative on others. Therefore such a test, if it is to be made, should only be performed between the tenth and the eighteenth days of the cycle. Moreover, it should not be forgotten that the finding of actively motile sperms in the canal does not necessarily indicate fertility, for a man may have a low sperm count and a high percentage of pathological cells and yet the sperms may show adequate motility. Therefore, since motility *per se* is no criterion of male fertility, all the test really tells us is that the husband is capable of depositing his seminal fluid in the neighbourhood of the cervix.

Where the husband's condition has been found satisfactory, and some definite lesion has been identified in the woman, that lesion should be dealt with according to its nature—a thickened hymen excised, a cervical polypus removed, a displacement rectified by operation, or a fibroid tumour removed by myomectomy.

Most important is the investigation of the cervix. An obvious infection of the cervix, or an erosion, should be suitably dealt with (p. 912). But other more subtle causes may have to be investigated. The secretory cells of the endocervix vary according to the ovulation and oestrogen cycle, and there is a corresponding cycle in the Fallopian tubes. It is demonstrable that the normal secretion of the cervical canal for most of the cycle is thick, viscid and opaque, but at the time of ovulation (three to five days) and for a few days just before menstruation this secretion becomes thin and crystal clear. Moreover, at this time not only does its pH reach an average of 8.5 and the secretion become loaded with mucin and glycogen, but the temperature of the canal rises to 99.6 or 100 degrees. Can it be doubted that the object of all these changes so easily demonstrated with platinum loop, nitrazine paper and thermometer are but to assist sperm migration? Therefore should any aberration of function be discovered—the result of contraception or gross infection—it will often be sufficient to remedy the cervical plug defect, or any condition that maintains the cervical mucous in a state of opacity and viscosity: for assuredly it is this infected and mechanical barrier that prevents proper migration of the spermatozoa into the endometrial cavity. Occasionally Nature is able to get over this difficulty by the process of orgasm, for this state results in a sudden outpouring of a highly alkaline thin fluid which washes away the hitherto viscid plug—its place being taken by a clear but permeable secretion. But should Nature not succeed, then this cervical barrier will need treatment by dilatation and drainage, or electro-cautery or short-wave therapy, with or without copious hot saline douches twice daily between the periods for three to six weeks.

Insufflation of the Fallopian tubes should be carried out if possible at the correct time of the cycle, and should there be any smallness of the external os, and especially if there is any dysmenorrhœa, it is wise at the same time to do a dilatation of the cervical canal up to the size of a No. 10 or 12 Hegar. Routine curettage should form no part of this operation and is better avoided, though it is often of scientific value to take a *biopsy scraping* of the endometrium, particularly if it should happen that the menstrual period is due in a few days, for in that way (though an anæsthetic is by no means needed to take an endometrial biopsy) it may be possible to determine the presence of anovulation by finding no secretory cells in the acini. Injections of pregnant mares serum (400 to 1600 units) between the sixth and twelfth days of the cycle have been used for anovular menstruation, but before initiating this treatment it is important to discover by repeated biopsies several months running whether anovular menstruation is habitual. Up to date, pregnant mares serum has been given more often empirically than scientifically, so it is difficult to assess either the value of the therapy or the real frequency of anovulation.

After complete investigation which includes hystero-salpingography in all cases where there is no dysmenorrhœa or other contraindication, the patient and her husband should be given general advice regarding what may be called the hygiene of conception. They should be informed that the most favourable time for intercourse is from the tenth to the sixteenth day of the menstrual cycle, and that too frequent intercourse is prejudicial. The importance of an adequate diet, with an ample vitamin content, of exercise and fresh air, and of sufficient rest—both mental and physical—should be stressed.

Finally, recent work on the subject would seem to indicate that under certain circumstances fully to be understood by both parties *artificial insemination* should be advised. In some sterility cases mechanical factors are responsible: in others there may be developmental errors; in still others one of the parties may be sterile whilst the other is fertile, or may be there are hereditary tendencies which it is inadvisable to transmit.

Should the husband's semen be available, and of 100 per cent. excellence, the modern technique is not difficult, though it is well to sound a preliminary note of warning that the success rate is rarely more than 40 per cent., but this can be improved if the insemination is repeated after the lapse of one day. If the sperm count should be below normal, centrifugalisation before injection may improve the chances of success.

The husband and wife are asked to reside in a house or hotel fairly close to the consulting room of the surgeon. The husband is requested to abstain from cohabitation for at least two weeks before the selected ovulation date, that is the twelfth to the sixteenth day of the normal cycle, or the fourteenth to fifteenth day from the first

expected day of the next period. At 8 to 9 A.M. coitus interruptus should occur, the husband ejaculating into a sterile dry jar (a condom should on no account be used). Within a maximum of one hour the wife presents herself at the consulting room with the jar, which should have been kept at room temperature and in no way heated. She is placed in the lithotomy position on a sand-bag. A speculum being inserted, the os is exposed and wiped clean. A half to one cubic centimetre of the semen (which liquefies within twenty minutes of emission) is then drawn up into a special pipette or syringe which is passed first into the external os and slowly injected. It is important to see that no air is injected with the semen, for if so there will be instant contraction of the uterus and possible extrusion of the contents. Before withdrawing the speculum it is a good plan to inject the remaining semen into the vault of the vagina so that the cervix is bathed in a seminal pool. A piece of wool is placed in the mouth of the vagina to prevent soiling, and the patient remains on her back in the elevated position for an hour. She then gets up and goes about her business.

In the event of the husband's semen being impotent there is at present no *legal* objection (provided both parties sign an affidavit to the effect that they know what is being done) to a donor providing the semen. The surgeon would, of course, be responsible for the genetic and health background, together with the sperm picture and racial type of the donor. *There are, however, moral and other objections which deserve most careful consideration, but which cannot be discussed here.*

BIRTH CONTROL—CONTRACEPTION ¹

General Remarks.—The gynæcologist or family practitioner is frequently asked by married women of all classes for advice and instruction on birth control. His attitude to such a request is clearly defined in respect to one specific group—he should advise contraception if in his opinion pregnancy would aggravate an existing disease to the extent of placing the woman's life in danger or of doing serious injury to her future health. It is not for him to advise the newly married who for personal reasons desire to prevent the occurrence of pregnancy, unless here again the state of health or very special circumstances indicate that to delay the occurrence of pregnancy would be definitely to her benefit. Whenever this rigid and rational line is extended, and conditions other than health are introduced as justifying the tendering of advice by medical men in regard to contraception, their foothold becomes less secure; although a scientifically controlled parenthood, to be referred to later, has the support of large numbers of both medical and lay public. Medical men have a very great responsibility in these days when contraception is being so extensively practised by married women for social, economic and selfish reasons. The falling

¹ The authors express their indebtedness to Dr Meave Kenny (First Assistant, Department of Obstetrics and Gynæcology, British Post-Graduate Medical School, University of London) for the assistance she rendered in drafting this section.

birth rate in this country (and in all Western nations) threatens race extinction if not arrested in the near future. The gravity of the situation is evident from the following figures :—

England and Wales

<i>Years</i>	<i>Total Births</i>
1915-17 . . .	2,268,500
1940-42 . . .	1,849,000

In a leading article in *The Times* of 6th April 1943, entitled “An Illusion of Stability,” the writer reviewing the birth rate made the following statement :—“In the years preceding the war the Net Reproduction Rate for England and Wales was 0·8. In other words, the number of female births fell short by 20 per cent. of the number which, other conditions being equal, would be required to replace in the next generation the women of reproductive age in the present generation. . . . The inauguration of a population policy with the aim of raising the net reproduction rate to 1 is more necessary than ever. It would be deplorable if the rise in the number of births in 1942, welcome as it is, should create an impression that the solution of the population problem may, after all, not be so urgent.

“The conclusion is that no basic change in the fertility pattern has so far taken place. The tide of reproduction, which has been receding for over sixty years, has not yet turned.”

Contraception is blamed by many for the falling birth rate and certainly it is a most effective means of limiting the family. But let it be clearly understood that it is the means—and a most useful and desirable means for limiting the family in individual instances— but it is not the motive. Putting aside the instances (and unfortunately their number is large) in which the motive is purely selfish, the great bulk of married women to-day, in agreement with their husbands, employ contraceptive measures for economic reasons—they dread unemployment and loss of income, they are concerned about house and rent and the education of their children—to mention only a few outstanding examples. It is not the province of the authors of this textbook to discuss remedies for this grave situation further than to state that in their opinion the Government should, and without further delay, appoint a widely representative body to consider the question in all its aspects (*they are many and varied*), and to make recommendations. A Royal Commission might or might not be the most suitable body to undertake the inquiry, but that decision rests with the Government.

Here would appear to be the most suitable point to draw attention to the fact that the two terms “contraception” and “birth control” are not synonymous. The aims of *contraception* are purely negative, viz., the prevention of conception, but *birth control* in its widest sense

and as advocated by so many to-day has aims of a positive as well as a negative nature—its motive is a planning and spacing of children to the best advantage of the family and of the State. It is claimed by large numbers of the community that this scientifically controlled parenthood should be the ultimate policy of an educated nation. Much can be said in favour of this rational eugenic policy provided married women shoulder their responsibilities. Married women cannot be expected to contribute families of Victorian proportions, and it is questionable if this is desirable; but to arrest the alarming fall in the birth rate is their responsibility, shared naturally with their husbands.

Mention too must be made of the injurious local effects produced by long-continued employment of contraceptive measures (*vide Sterility*, p. 818)—possibly these are exaggerated by the opponents to contraception and minimised by its advocates. This, however, can be most definitely stated, that it is highly undesirable and prejudicial that young couples should start off married life and freely employ contraceptive measures.

Indications.—Let us now consider the specific conditions or circumstances under which a medical practitioner is justified in prescribing contraceptive measures. We would stress the point that the indications mentioned are almost identical to those for which *therapeutic abortion* is recommended and employed. Contraception is therefore the alternative, and a more rational and safer alternative than induction of abortion—it comes into the category of preventive medicine. But with this difference, that in many instances the *test of pregnancy* may have to be employed as not infrequently it is impossible to predict the effect of pregnancy on an individual the subject of a grave disease.

(1) *Chronic Renal Disease, Chronic Hypertension.*—Repeated toxæmias of pregnancy (*vide* p. 216).

(2) *Pulmonary Tuberculosis* until the lung lesions are healed (p. 278), and other forms of active tuberculous disease.

(3) *Advanced Cardiac Disease.*—In cases of this nature great discretion must be exercised in recommending contraception, as can be judged by considering what has been written on cardiac disease as a complication of pregnancy (p. 242). Contraception is obviously advisable in the woman who has had several children and falls into Group III. In the vast majority of cases, however, the test of pregnancy must be permitted with the *dernier ressort* of induction of abortion or premature labour in reserve.

(4) *Repeated Pregnancies at Short Intervals which are Definitely Undermining the Health of the Patient.*—Some women are peculiarly prone to fall pregnant. While very many are unaffected by repeated pregnancies at short intervals, in a large number the general health is undermined. With each succeeding pregnancy the increasing incidence of grave complications (accidental hæmorrhage, placenta prævia, postpartum hæmorrhage, etc.) has also to be taken into account (p. 761).

(5) *Diabetes, Thyrotoxicosis, Disseminated Sclerosis* or other grave diseases of the central nervous system.

(6) *Severe Recurrent Pyelitis* during pregnancy might also be justifiably included.

To extend the above list and include other conditions (*e.g.* deaf mutism) on eugenic grounds is more than the authors feel justified in doing at present. They fully realise, however, that in the course of time the employment of contraception on purely eugenic grounds may have to be considered most carefully—to give a specific example, in cases in which one or both parents have a very bad mental history.

The Church has interested itself in this problem. The Roman Catholic Church bans the giving of contraceptive advice in any circumstances. It must be pointed out, however, that it does permit three methods of birth control to be practised by its members, *viz.*, complete abstinence, “safe period” intercourse and *coitus reservatus* or *carezza*. The ban, therefore, is only on the chemical and mechanical means of family limitation described below and on *coitus interruptus*. Generally speaking, all other Catholic Churches view with disfavour the employment of contraception, but not to the same extent or so definitely as does the Church of Rome.

Contraceptive Technique.—The necessary characteristics of all good methods are that they should be effective, harmless, easy of application and cheap. Every doctor should check the proposed method against these standards, bearing in mind too that the method advised must be psychologically acceptable to both parties of the marriage. The means available are :—(1) *Mechanical*. Protection of the os uteri against direct insemination. (2) *Chemical*. Killing of the spermatozoa deposited in the vagina. The orthodox method is a combination of these, that is, the use of a mechanical barrier and a chemical spermicide. The form of barrier used varies with the parity of the patient. Nulliparæ are generally advised to use the Dumas cap, which is a shallow basin of thin rubber with a solid rounded rubber rim. Its retention in position is assured by careful fitting into the vaginal vault and the good tone of the vaginal canal. Multiparous women with lax vaginal walls are better served with a large cap, a slightly convex diaphragm of thin rubber within a rubber-covered watch-spring pessary. The “Racial” or “Pro Race” cap, which fits closely by accurate size and suction to the nulliparous cervix, is not recommended as its prolonged use may cause damage. Male sheaths or condoms of various materials are also in general use, but are psychologically unacceptable in many cases. All the above should be used in combination with chemical spermicides applied to both surfaces for greater protection; the best known of these are G.P. ointment and Volpar jelly, neither of which has been shown to affect deleteriously the vaginal secretions. The cap should be left in place for at least ten hours after intercourse and its removal preceded by a vaginal

douche of 1 in 500 lactic acid or tap water. With proper care the proportion of failures is only 1 or 2 per cent. in many thousands of cases reviewed by various authors. The widely advertised but quite unreliable chemical contraceptives on the market have usually a quinine base which may affect susceptible individuals and retention of their residue may set up a vaginitis.

Some experienced gynæcologists hold that alteration of the *pH* of the vagina, erosion of the cervix and decreased permeability of the cervical mucous plug may result from the use of mechanical and chemical contraceptives of the types mentioned and thus cause permanent sterility. Birth-control specialists deny this and quote in their support the frequent occurrence of these conditions in the absence of any contraceptive practice.

Most gynæcologists agree in condemning any form of *intra-uterine* appliance such as the metal "wish-bone" or "ring" left in the uterus for months or years, and acting by preventing the embedding of the fertilised ovum or by causing its early abortion. Such pessaries have been known to track through the uterine wall and to be recovered from distant sites, or have been visualised by X-rays embedded in the pregnant uterus.



FIG. 329.—COMPLETE PROCIDENTIA.

CHAPTER XLIV

DISPLACEMENTS OF THE UTERUS AND ALLIED CONDITIONS

Introduction—Prolapse—Backward Displacements—Forward Displacements—
Lateral Displacements—Inversion

INTRODUCTION

SOME writers of critical reviews of this work have questioned the necessity of going into so much detail regarding uterine displacements, more particularly in respect to *forward* and *backward* displacements. As teachers of obstetrics and gynecology hold very varied views, and the "Combined Textbook" has a wide circulation throughout the British Empire, the authors have deemed it advisable to present a reasoned argument of the subject and in considerable detail.

The term "uterine displacement" is used clinically to describe a number of conditions, some of which are not true displacements of the uterus. Literally, it should include only conditions in which the whole uterus is displaced from the normal situation, but it has been extended to embrace conditions in which the axis of the uterus has undergone alteration—*prolapse is the only genuine displacement*.

Before describing the different displacements in detail we would remind our readers of a few anatomical features, dealt with more fully in Chapter II, which have a bearing on the subject.

The normal uterus lies in the pelvis with the corpus uteri bent forward on the cervix at an angle of 170° (Fig. 330 (1)). In the erect posture, with the bladder empty, this anteflexion brings the body of the uterus almost horizontal and about one finger's-breadth below the upper border of the symphysis pubis; it lies at an angle of 60° to the vagina. The vagina is placed at an angle of 60° to the horizontal, and is therefore parallel to the pelvic brim. The external os lies centrally in the pelvis—a little above the level of the ischial spines.

A line joining two points, an inch above the ischial spines, will be found to pass through the uterus at the isthmus. Round this transverse axis the uterus has freedom of movement, more particularly antero-posteriorly; lateral movement is limited, as is also descent.

The anterior surface of the uterus rests on the upper surface of the bladder, and as the latter organ fills up, the body of the uterus is raised with it (Fig. 330 (2)). Some coils of small intestine rest on the posterior or upper surface of the uterus. These conditions, and intra-abdominal pressure prevent any sudden and extensive change of position of the uterus when the patient stands up or lies down. The urethra, and the canal of the rectum (except its last inch) run

parallel to the vagina, and are therefore parallel to the pelvic brim. These three canals—the urethra, the vagina and the rectum—are all

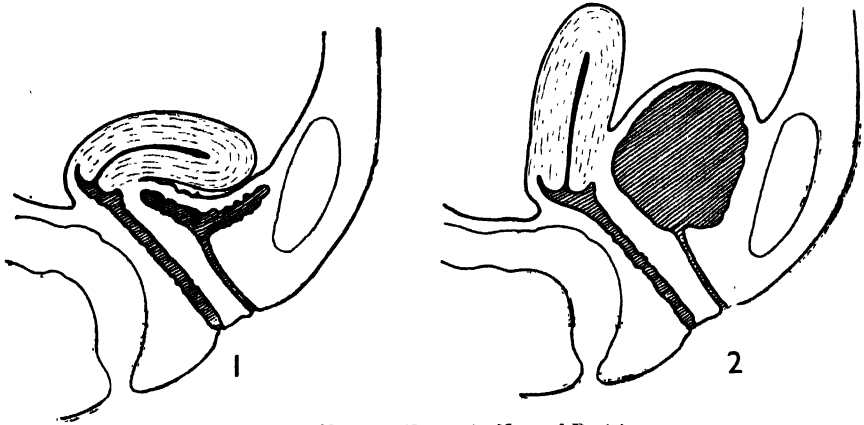


FIG. 330.—Showing Uterus in Normal Position.

1. Bladder Empty. 2. Bladder Full.

supported by the fibres of the levatores coccygei muscles and processes of the recto-vesical fascia which encircle the walls of all three.

The anatomical names given to certain structures attached to the

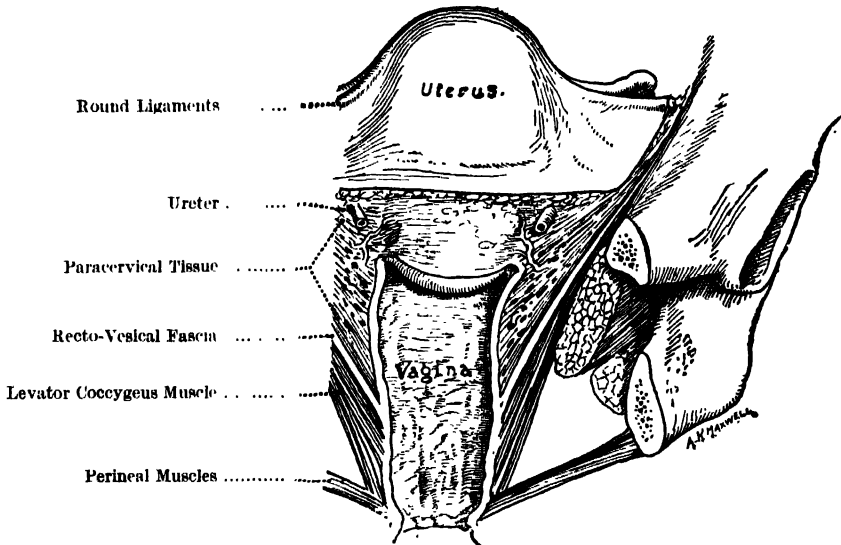


FIG. 331.—Diagram showing Uterine and Vaginal Supports.

uterus—*e.g.* the broad ligament, the round ligament—indicate the old idea that they were the principal supports of that organ. We now know that these structures cannot serve as ligaments in the ordinary sense. It is most convenient to consider the uterine and vaginal supports as divided into four tiers from above downwards (Fig. 331):—

- | | |
|---------------------------|-----------------------------------|
| (i) Uterine ligaments. | (iii) Levatores coccygei muscles. |
| (ii) Paracervical tissue. | (iv) Perineal muscles. |

(i) **UTERINE LIGAMENTS.**—The so-called ligaments of the uterus—*i.e.* the *broad* and the *round ligaments*—have already been described (p. 31). So far as they exert any influence on the position of the uterus, they merely act as “stays” and help to steady the fundus.

(ii) **PARACERVICAL TISSUE.**—The paracervical tissue (Fig. 332) is a mass of cellular tissue surrounding the cervix, through which pass many blood-vessels, including uterine arteries and veins, with nerves and lymphatics—passing forwards through it also, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch distant from the cervix, is the ureter. This tissue forms the supporting framework for these vessels and nerves, and constitutes the principal support of the uterus.

The paracervical tissue is composed of very strong connective tissue, with a certain amount of smooth muscle fibres. Above it is continuous with the cellular tissue in the base of the broad ligament, while below its fibres pass into the recto-vesical fascia.

Posteriorly, two special bundles pass back to be attached to the anterior surface of the lower portion of the sacrum, forming the *utero-sacral ligaments*. Anteriorly, a thin layer passes forwards beneath the base of the bladder to be inserted into the posterior surface of the pubes—*utero-vesical ligaments* (Fig. 332 (C)). The strongest

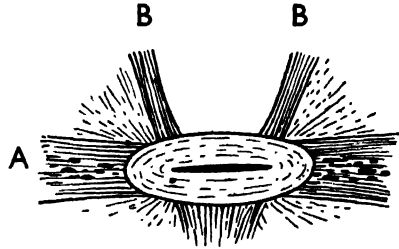


FIG. 332.—Diagram showing Distribution of Paracervical Tissue, the chief support of Uterus. Cervix is seen cut across.

A. Lateral and Main Portion (Transverse Ligaments, etc.). B. Utero-sacral Ligaments. C. Thin Portion which extends forwards under Bladder (utero-vesical ligament).

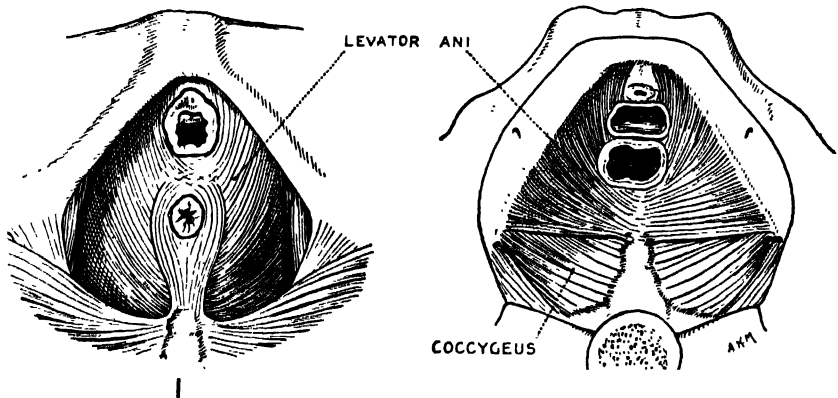


FIG. 333—Pelvic Floor or Diaphragm.

1. From below (Perineal Muscles removed). 2. From above (Superstructures removed).

development of the tissue is found laterally—*lateral ligaments*. The most important advance in our knowledge of the “applied” anatomy of the pelvis is realisation of the fact that the lateral masses of paracervical

tissue are the chief support of the uterus in the pelvis. Involvement of this tissue in infections of the cellular tissue of the pelvis, or in metastatic growths from malignant disease, causes absolute fixation of the uterus. At the operation of hysterectomy, abdominal or vaginal, the uterus cannot be pulled up or down freely until the paracervical tissue has been divided.

(iii) **LEVATORES COCCYGEI MUSCLES.**—These muscles and the superposed recto-vesical fascia have been described (p. 35), and are illustrated in Figs. 331, 333. This muscular shelf running from each side of the pelvis encircles the rectum, vagina and urethra some distance below the cervix ; it has no attachment to the uterus and therefore does not act as a direct support of the uterus—it keeps up the rectum and vagina.

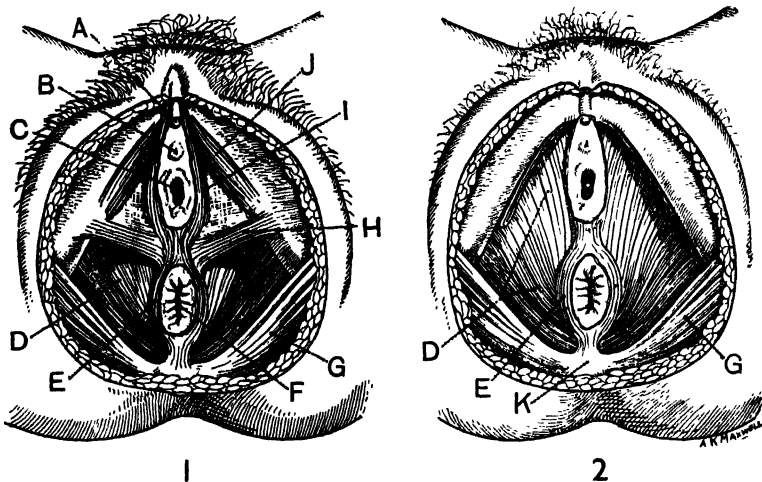


Fig. 334.—Showing Pelvic Diaphragm and Perineal Muscles.

1. Superficial Dissection. 2. Deep Dissection.

A. Clitoris. B. Urethra. C. Vagina. D. Levator Coccygeus. E. Sphincter Ani Externus. F. Anus. G. Gluteus Maximus. H. Transversus Perinæ. I. Bulbo-cavernosus. J. Ischio-cavernosus. K. Coccyx.

(iv) **PERINEAL MUSCLES.**—The perineal muscles (Fig. 334) keep the vaginal orifice and the anus closed—they do not act as direct supports to the pelvic viscera. They contract during intercourse and defæcation, and are overstretched and frequently torn during parturition.

PROLAPSE OF UTERUS AND VAGINAL WALLS

While this chapter deals particularly with displacements of the uterus, descent of the vaginal walls is so intimately associated with uterine prolapse that the two are considered together.

Prolapse of the uterus does not occur without prolapse of the vaginal walls ; it is possible, however, to have prolapse of the vaginal wall while the uterus remains in its normal position. Many patients

are referred to hospital with a diagnosis of "prolapse of the uterus," whereas the vaginal walls alone have come down.

Prolapse of the uterus is a very common occurrence among parous women. It occurs in its grossest form (*procidentia*) most commonly in women of the industrial class who are engaged in hard manual or domestic work; in those not so engaged, minor degrees are common, and especially prolapse of vaginal walls.

Ætiology.—The cause is primarily some injury to or defect in the paracervical tissue, which, as we have just seen, is the chief support of the uterus. The injury may happen if forceps is applied before the os is fully dilated—in this event not only is the foetal head dragged downwards, but the lower portion of the uterus is carried in front of it until the cervix stretches or tears to allow the head to escape. A less degree of the same injury takes place even in cases where there has been complete dilatation, if forceps has been applied while the head was high in the pelvis and within the cervical ring. In the latter, no matter how carefully the blades are applied, and no matter how perfect the design of the axis-traction forceps employed, traction always results in lessening flexion of the head. As a result a slightly bigger diameter of the head is dragged through the paracervical ring of tissue, and this ring descends a little in front of the head. With these occurrences the paracervical tissue is overstretched, bruised, or torn, and as a result the cervix may be afterwards less firmly anchored.

There is a considerable number of cases, however, in which the labours have been spontaneous (p. 770). In some there may be evidence of want of tone in other tissues—*e.g.* enteroptosis, varicose veins or hæmorrhoids and lax abdominal muscles. A similar laxity may obtain in the paracervical tissue. It is difficult to explain such cases, but two possibly favouring factors are (a) bearing-down efforts early in labour before the head has passed through the cervix; (b) early rising in the puerperium and straining efforts in the first few weeks following labour while the uterus is still heavy. Microscopic examination of the paracervical tissue in prolapse has shown an atrophy of smooth muscle fibre, with a loosening of the white fibrous tissue—some writers attach great importance to this as a cause.

Very occasionally uterine prolapse may occur in nulliparous women if the chief supports have not maintained their normal relationships. A severe accident may cause the paracervical tissue to be wrenched or torn. Then there are instances in which the prolapse is due to congenital weakness of the uterine supports and a laxity of all the tissues.

Occasionally a neoplasm in pelvis or lower abdomen in the course of its growth pushes the uterus downwards, but such cases are great rarities.

While the factors mentioned above cause the original lesion, the

progress of prolapse is aggravated by increased intra-abdominal pressure. Where the uterus becomes tilted backwards, as it does in the first stage of prolapse, the small intestines come to lie on its anterior surface—it is thus placed at greater mechanical disadvantage to resist pressure from above. Among the circumstances which may act as secondary causes of prolapse are hard manual labour, chronic bronchitis, and the recurrent straining at stool caused by chronic constipation.

Local Signs of Prolapse.—Following delivery with paracervical tissues overstretched, the uterus, which is heavier than normal owing to its being still in the process of involution, sags a little in the pelvis. This sinking of uterus causes the fundus to tilt backwards—at this stage the uterus is in the *first degree of prolapse* (Fig. 335). Once the long axis of the uterus is lying in the axis of the vagina, the descent may continue until the cervix reaches the vaginal orifice, so forming the *second degree of prolapse*. Where descent continues farther, the uterus protrudes through the vaginal orifice with the greater part of the vaginal walls everted—this *third degree of prolapse* is referred to as *procidentia*.

In front, the bladder is dragged down of necessity because of its attachment to the vaginal wall and cervix. A sound introduced through the urethra can be used to demonstrate that the bladder extends almost to the tip of the cervix in complete procidentia (Fig. 335). At a higher level the utero-vesical pouch of peritoneum descends.

The uterus, as it prolapses, pulls down also the posterior fornix and the vaginal wall, but without necessarily dragging the rectum with it, because the posterior wall is only loosely adherent to the rectum except in its lowermost part. The pocket of peritoneum which in the pelvis forms the pouch of Douglas also descends. *In complete procidentia, then, there is a hernia of the uterus through the pelvic diaphragm.* and it drags with it the bladder in front and the posterior vaginal wall behind. The Fallopian tubes, ovaries and coils of intestines may be included in the large prolapsed sac.

When the patient lies down replacement as a rule is easily effected: very rarely indeed does it happen that inflammatory changes with adhesions render the mass irreducible.

The external os is at first œdematous, owing to congestion produced by the altered course of the uterine vessels; this œdema gives place later to hypertrophy. The cervix may be the seat of old lacerations, and glairy mucus from the endocervical glands may be seen escaping from the external os.

In persistent cases the vaginal mucous membrane becomes much thickened and dry. The irritation of the patient's clothing frequently causes patchy ulceration, especially on the lower part of the anterior vaginal wall and cervix, the ulcers assuming a punched-out circular

form about 1 to 1½ inches in diameter (Fig. 329). Curiously enough *these ulcers seldom become malignant* (p. 962).

The stages in the process of uterine prolapse can be best appreciated if after the procidentia has been reduced the patient is asked to strain. It will then be observed that the vaginal wall just behind and above the urethral orifice appears at the vulval orifice; it is followed by the rest of the anterior vaginal wall from below upwards until the cervix appears. When the cervix is completely extruded, the whole of the anterior wall is exposed. As the cervix passes through the vulva, it drags the upper part of the posterior vaginal

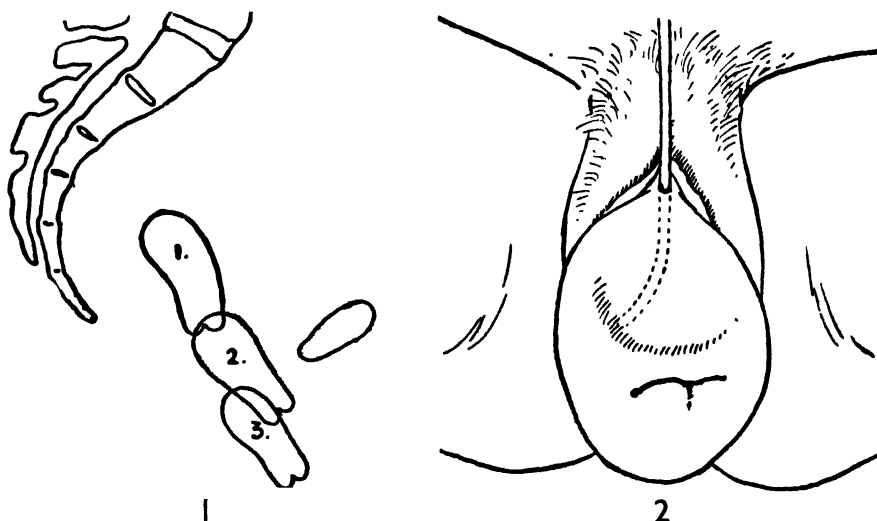


FIG. 335.—Prolapse of Uterus.

1. Degrees of Prolapse of Uterus. 2. Complete Procidentia with Sound in Bladder.

wall with it, and eversion of this wall is completed from above downwards.

PROLAPSE OF THE VAGINAL WALLS.—In the course of uterine prolapse we have seen that the vaginal walls necessarily accompany the descent of the uterus. These walls, however, may descend while the uterus still remains at its normal level in the pelvis as a result of injury or overstretching of the fibres of the levatores coccygei muscles which encircle the vagina.

Cystocele.—Prolapse of the anterior vaginal wall is always associated with a descent of the bladder, because the walls, vagina and bladder are closely adherent—this forms the condition of cystocele.

The support of the floor of the bladder is much less firm than that of the uterus. Fibres pass forward from the paracervical tissue underneath the base of the bladder to be inserted into the posterior surface of the symphysis pubis, and fibres from the levatores coccygei muscles, with the recto-vesical fascia, complete the support. It is a

comparatively thin platform, however—the tissues are easily over-stretched or torn during parturition.

Extraction by forceps without previous emptying of the bladder is a frequent cause of cystocele. Even in cases where forceps is not applied, the protrusion of a part of the vaginal wall in front of the head during delivery may be the origin of a cystocele; this is the reason why it is so important to keep the bladder empty during labour and thus prevent the anterior vaginal wall being pressed down in front of the presenting head.

In many cases the development of cystocele is favoured by a simultaneous damage to the perineum. In the nulliparous woman, as the vagina runs at an angle of 60° to the horizontal, its anterior wall is supported by the posterior vaginal wall and

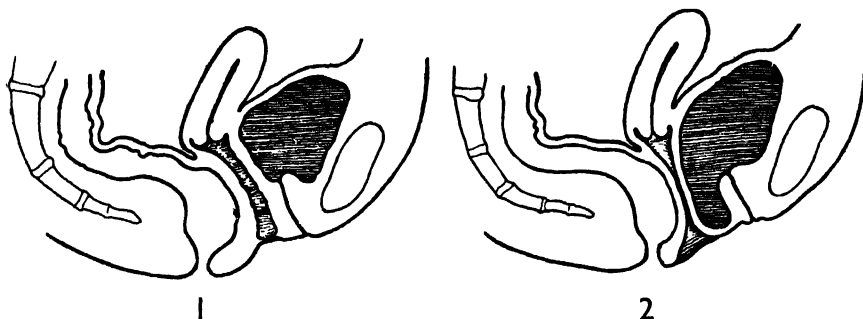


FIG. 336.—Showing how a Cystocele develops.

1. Perineal Body intact; Anterior and Posterior Walls in apposition.
2. Perineal Body torn; Cystocele coming down.

perineal body (Fig. 336 (1)). If the perineum is torn the anterior vaginal wall loses part of its normal support and therefore descends easily (Fig. 336 (2)).

Cystocele may occur, however, with an apparently intact perineum, but in such cases examination usually reveals that, though the superficial area seems intact, the vaginal orifice is lax, as a result of overstretching of the levatores coccygei muscles at the time of delivery.

The extent of a cystocele can be gauged by getting the patient to strain as she lies on her back. The wall descends in the same way as has been described for cases of prolapse of the uterus, and as illustrated in the above figure.

Rectocele.—The union between the rectum and the posterior vaginal wall is much less intimate than that between the bladder and the anterior wall. This looseness saves the rectum from being dragged down to a like degree in cases of procidentia and prolapse of posterior vaginal wall.

If the perineal body has been torn and, in the process of healing, there has been cicatrisation of the vaginal with the rectal wall, the

lower portion of the vaginal wall remains fixed and the part immediately above may be pushed downwards as a true rectocele (Fig. 337). For the exact diagnosis of a rectocele it may be necessary to insert a finger into the rectum and explore the direction of the anterior rectal wall.

It occasionally happens, more especially following on vaginal and perineal repair, that the uppermost part of the posterior vaginal wall with the rectum comes down, the lower part remaining in a satisfactory position; this condition may be difficult to correct by operation. A very rare condition (*enterocele*) in which a loop of small bowel protrudes as a hernia through the posterior vaginal vault may simulate a high rectocele (Fig. 338).

Should the tear of the perineum be complete, the torn walls

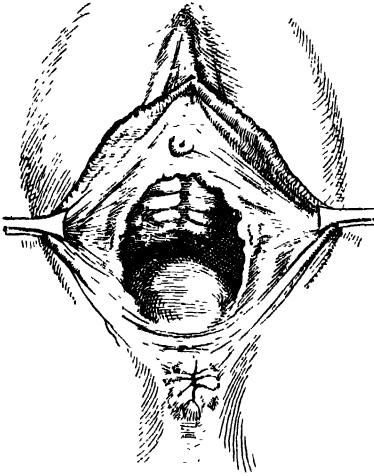


FIG. 337.—True Rectocele.

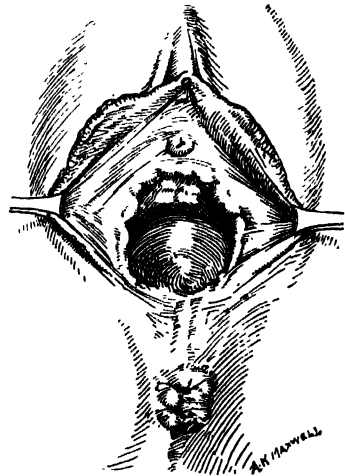


FIG. 338.—Enterocele (very rare condition).

retract and heal in the retracted position: in such circumstances a rectocele cannot develop. Prolapse of uterus is a very rare occurrence if there is a complete tear of the perineum.

The conditions which aggravate rectocele are the same as those which have been described as favouring prolapse—hard manual work, bronchitis and straining at stool.

HYPERTROPHY OF THE SUPRAVAGINAL PORTION OF THE CERVIX.—In prolapse, as we have seen, there is usually considerable enlargement of the cervix, associated in the first place with œdema, and later with chronic inflammatory changes in the tissues—such changes affect more particularly the *vaginal portion of the cervix* and are considered elsewhere (p. 906). As prolapse progresses, however, an *overgrowth of the supravaginal portion* of the cervix may occur, so great as to allow the external os to protrude at the vulva without the fundus of the uterus descending to any great extent—this condition is often

erroneously diagnosed as "prolapse of the uterus," when in point of fact there may be very little prolapse of the body of the uterus.

Its ætiology is not quite simple. In some cases the overgrowth is the result of chronic inflammatory changes. In other cases the drag of the vaginal walls, more especially the cystocele, produces an elongation of this particular portion of the cervix.

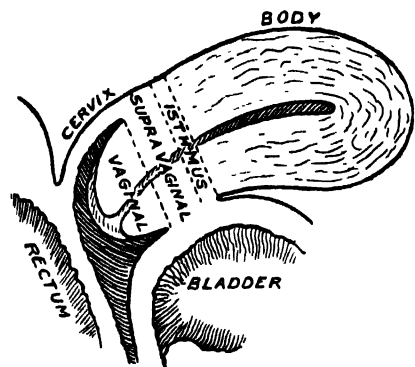


FIG. 339.—Divisions of Cervix.

cervix appears at the vulva before the vaginal walls become everted.

Clinical Features and Diagnosis.—In the various types of "prolapse" the patient has usually a feeling of want of support in the pelvis. She complains of a feeling of weight and "bearing down" in the pelvis, and often of a dragging pain in the back, referred to the upper sacral region. She may state that "something comes down," but such a description is often applied by her to other conditions, such as hæmorrhoids or even urethral caruncle. She may complain of actual difficulty in walking, particularly, of course, if procidentia has developed. In many cases her discomforts do not become marked until she is over-tired through remaining too long in the erect posture.

Disturbances of micturition are frequent. The descent of the cervix allows a pocket of the bladder to lie at a lower level than the urethra, so preventing complete emptying of the bladder. Residual urine always favours the development of cystitis. In the "procidentia" type the patient is occasionally unable to pass urine until she presses up the prolapsed mass with her fingers.

The exposure of the external os and of the vaginal walls leads to chronic inflammatory changes in the cervix and the vaginal walls, associated with excessive leucorrhœal discharge from both surfaces. There may also be excessive menstrual periods. The formation of ulcers on the vaginal mucous membrane and cervix has already been mentioned (*vide* Fig. 329, p. 836).

In cases of procidentia a diagnosis is obvious by simple inspection. The hypertrophied cervix, the external os and the everted vaginal mucous membrane are unmistakable.

In the lesser types inspection and vaginal examination will reveal the extent of perineal laxity or damage, the presence of hypertrophy of the cervix and the depth of the fornices. The patient should be asked to strain and the degree of descent of the cervix and vaginal walls should be carefully noted by the fingers in the vagina.

The only conditions which simulate prolapse of the uterus of a minor degree are fibroid polypus of uterus and hypertrophy of the cervix; and the only conditions which simulate prolapse of the vaginal walls are a cystic or solid tumour of the walls and an enterocele.

Fibroid Polypi.—These tumours are well-defined swellings in the vagina above which the ring of the cervix can be felt. The fundus is at its normal level.

Hypertrophy of Cervix.—*Hypertrophy of the supravaginal portion of cervix* and its relationship to uterine prolapse have been described. In *hypertrophy of the vaginal portion* the cervix is revealed by vaginal examination as broad and roughened; the vaginal fornices are of normal depth and the fundus is at its normal level. There is no appreciable descent of the cervix when the patient strains. In the case of hypertrophy of the *vaginal portion of cervix of congenital origin* (p. 907), the cervix is smooth in outline and very conical in shape.

Vaginal Tumours.—In some cases of descent of the vaginal walls, it may be necessary to consider whether the bulging of the wall is due to prolapse or to a solid or cystic tumour in the wall. Fibromyomata of the vagina usually develop from the central longitudinal muscle fibres of the anterior or posterior walls (p. 899); but cysts are usually slightly lateral (p. 898). The cervix is found above the tumour in each case. For confirmation of the diagnosis a sound may be passed into the bladder or a finger into the rectum. Vaginal tumours descend a little when the patient strains, and this should be remembered when making a differential diagnosis.

Vaginal Enterocele.—This very rare condition (Fig. 338) occurs when a loop of small intestine in the pouch of Douglas protrudes through the posterior fornix. The hernia must be differentiated from a rectocele. This can be done by inserting the forefinger of the left hand into the rectum and the forefinger of the right hand into the vagina. On pressing these fingers together, the loop of bowel will slip upwards.

Treatment.—The surgical pathology of the various types of prolapse described makes it obvious that by no form of treatment other than surgical (Chapter LVI) can the condition be rectified. The cases which require special consideration here are those in which attendant circumstances, *e.g.* pregnancy, extreme debility, old age, may render operation inadvisable. In such, temporary measures, as

the wearing of a mechanical support or pessary, may have to be employed.

Prolapse associated with pregnancy calls for special consideration—operation must be postponed until the process of involution after parturition is completed. During the early months of pregnancy the softening of the tissues may cause the uterus to descend further than it has done before. In such an event a pessary may be worn until the sixteenth to eighteenth week, by which time the size of the uterus enables it to support itself as an abdominal organ.

Pessary treatment can never cure prolapse; therefore, to advise a patient to wear a pessary, other than as a temporary measure, is to condemn her to do so for the rest of her life. This foreign body lies in the vagina, acting as a constant irritant to the mucous membrane, keeping the walls on the stretch, doing nothing to strengthen the tissues, and compelling the patient to make periodic visits to her doctor to have it removed and cleansed. Most patients, therefore, who refuse operative treatment at first, soon get tired of wearing a pessary and elect to have an operation.

For patients on whom operation is inadvisable on account of grave disease, debility or old age, treatment by pessary may be the only possible course. It is surprising, however, to find how well elderly patients stand operation for this condition.

If the perineum is not badly torn and the prolapse is of minor degree, a Hodge pessary may be sufficient (Fig. 340 (1)). When the vaginal orifice gapes, a ring pessary will have to be employed. The rigid vulcanite or celluloid ring is preferable; it is cleaner than the watch-spring pessary described below. For cystocele, the "boat" or "cradle" pessary is useful (Fig. 340 (2))—when straining takes place, the upper curved bar is pressed downwards and the lower bar pushes the bladder upwards. Another useful pessary for this condition is the modified "Hodge," with two parallel transverse bars just above the lower bar (Fig. 340 (3)); these transverse bars support the vaginal wall. These pessaries should be inserted in the manner described later (p. 858).

The pessaries most in use for prolapse are made of watch-spring, covered with soft rubber (Fig. 340 (4)). They are easily inserted, reach their proper position without difficulty and are, as a rule, very comfortable. The flexibility allows the ring to be squeezed into two parallel bars while it is being inserted through the vaginal opening (Fig. 340 (5)).

Circular pessaries act by stretching the vagina so widely that the uterus is supported above the pessary. Pessaries of this nature are ineffective, however, if the perineum is so relaxed or torn that it will not retain even a large ring.

In elderly women who are opposed to operative treatment it is a

very good plan to teach them how to remove and insert the rubber ring (this is the only variety of pessary in which it is possible). The instrument should be removed at night, placed in antiseptic lotion and reinserted in the morning before rising.

If the perineum is torn to the extent that a watch-spring pessary cannot be retained, or if the vagina is very shallow, it may be necessary in very elderly women to employ a "cup and stem" pessary, in

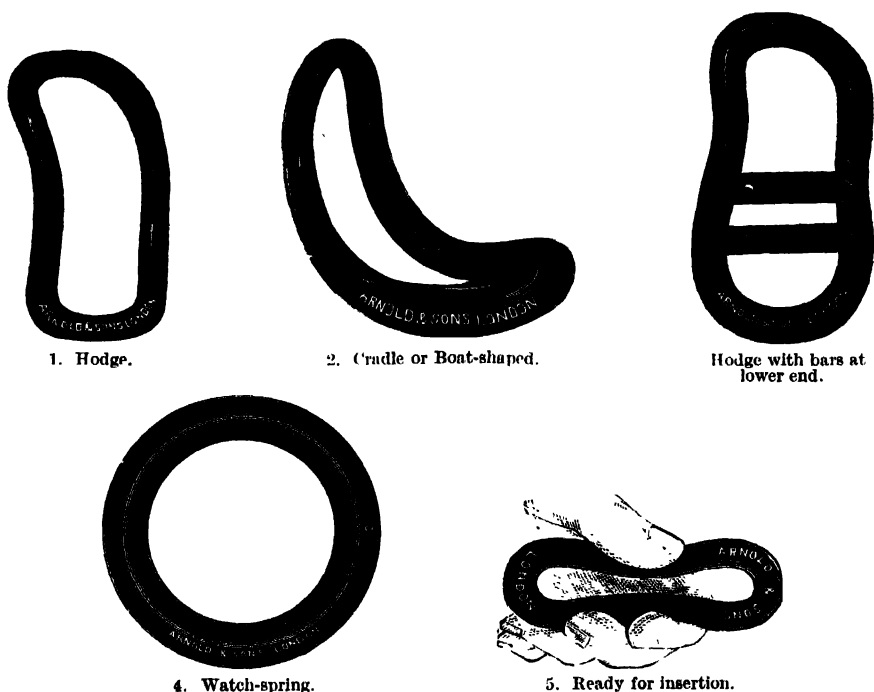


FIG. 340.—The various Pessaries which may be employed for Prolapse of Uterus.

which the vaginal stem is suspended by rubber bands from a waist belt (Fig. 341). This is a very unsatisfactory type of instrument, and is now very seldom employed.

All patients wearing a pessary should douche the vagina regularly, and have the instrument changed at regular intervals. A neglected pessary may become overgrown by vaginal mucous membrane, causing a great deal of local discomfort and injury. On occasions it has been found necessary to dissect out a pessary which had been retained for years imbedded in the vaginal wall.

In the surgical treatment of prolapse the earlier attempts made to correct the condition were very simple plastic operations. These did not deal adequately with the relaxed paracervical tissue. The development of abdominal surgery then led to attempts to treat the condition by stitching uterus to abdominal wall (*ventro-fixation*,

(Chapter LVI). This method, while it held up the uterus, did not always hold up the overstretched vaginal walls, and so in many cases cystocele

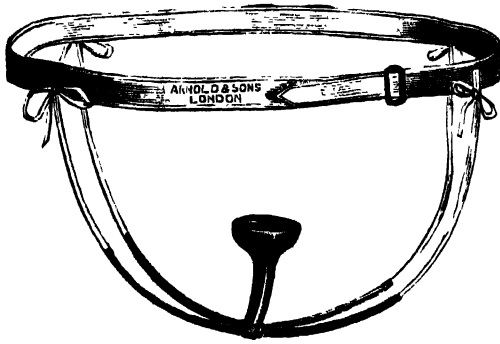


FIG. 341.—“Cup and Stem” Pessary for Prolapse.
(Very rarely used.)

persisted. The modern practice is to carry out surgical treatment of prolapse entirely from the vagina. The bladder is pushed upwards, the relaxed paracervical tissue and vaginal walls are tightened up, and the perineum is restored. In cases of hypertrophy of the supravaginal cervix, as well as in those cases of prolapse where there is much hypertrophy of the vaginal cervix, ampu-

tation of the cervix is carried out in addition. The operation is described, as is also vaginal hysterectomy (Mayo's operation), the alternative procedure favoured by a number of gynaecological surgeons, in Chapter LVI.

BACKWARD DISPLACEMENTS OF THE UTERUS

There still exists great difference of opinion regarding the clinical importance which should be attached to backward displacements of the uterus—the term “displacement” being here used in its clinical sense to include what may really be a malformation. Routine examinations have shown that: (a) 20 per cent. of women have the uterus directed backwards, without ever having had any symptom attributable to the displacement; (b) many women who complain of certain symptoms commonly associated with gynaecological conditions, and are found to have the uterus directed backwards, still complain of the same symptoms after the position of the uterus has been corrected; (c) a number of women are relieved of their local and general discomforts by replacing the uterus in its normal position and retaining it there by a pessary—this is the most useful test in cases in which there is doubt as to the significance of the displacement.

Classification and Ætiology.—The varieties of backward displacement are: (1) *retroposition*, true backward displacement of the uterus; (2) *retroversion* of the uterus, where the cervix remains at its normal level, the body being occasionally underdeveloped—usually a congenital condition; (3) *retroversion*, where the cervix has sunk a little below its normal level—first degree of prolapse; (4) *retroflexion* where the cervix remains in its normal position but the body is flexed backwards (Fig. 342).

(1) **RETROPOSITION.**—The whole uterus is placed back in the pelvis, due to (a) a developmental error, (b) a tumour of the uterus or ovaries pushing the uterus backwards, or (c) a pelvic inflammatory lesion, such

as a cellulitis or a salpingo-oöphoritis, dragging the uterus backwards. The two latter types are considered in connection with the diseases mentioned.

The variety due to a developmental error arises if the normal forward movement of the uterus, from the retroposed position which it usually occupies in the newborn child, does not take place prior to puberty. If the growth of the uterus proceeds normally in that position a typical retroposed uterus will result ; if growth also is arrested, a retroposed infantile uterus (with the ante flexion of the newborn condition persisting) will result (p. 859).

The retroposed uterus of normal formation is associated with no symptoms and so calls for no treatment.

(2) RETROVERSION WITH CERVIX AT NORMAL LEVEL (Fig. 342 (2)).—This condition may be the result of the pressure of tumours or the

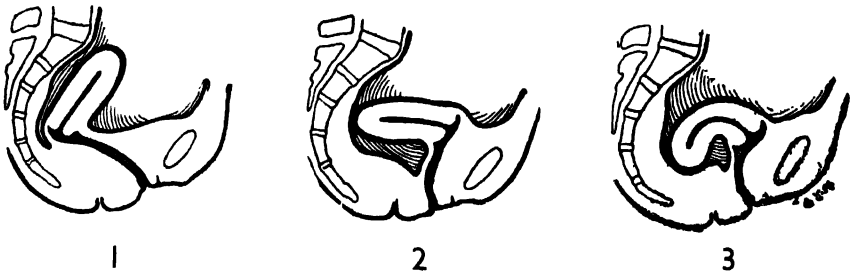


Fig. 342.—Showing the different varieties of Retrodisplacement.

1. Retroposition. 2. Retroversion. 3. Retroflexion.

dragging of inflammatory processes. In such cases the malposition of the uterus is of lesser importance than the condition causing it.

In most cases of uncomplicated retroversion the lesion is congenital ; associated with it there may be an underdevelopment of the uterus. The position of the genital tract in the foetus may vary slightly. When it lies near the ventral aspect, there is not the normal degree of anteversion of the uterus *re* the axis of the vagina ; therefore, when the uterus increases in size, as it does before puberty, the body tends to swing backwards and the abnormal position is maintained or aggravated by the weight of the organ, the superimposed loops of bowel, and intra-abdominal pressure.

In exceptional cases, an acute retroversion of the uterus may result from an accident where there had been a sudden jolt or fall.

Retroversion of the congenital type is common, but is seldom associated with symptoms. In a few cases irregularities in menstruation with pelvic discomfort may be present ; the latter condition occurs particularly in cases associated with chronic constipation. The ovaries tend to prolapse alongside the retroverted fundus in which position they may become congested and, falling into the pouch of Douglas, may be pressed upon by the retroverted uterus. Should this occur, pelvic pain or uneasiness will almost certainly result (p. 991).

This malposition of the uterus has been cited as the cause of abortion in the recently married ; many women with this abnormality, however, do not abort, and the uterus rises out of the pelvis without difficulty. This type of displacement is not benefited by the wearing of a pessary.

(3) **RETROVERSION WITH DESCENT OF THE CERVIX.**—This condition is really the first degree of prolapse. It differs from the previous type in that it is associated commonly with a feeling of weight, “bearing down,” and with pelvic weakness. It originates in the puerperium after the tenth to the fifteenth day, by which time the uterus has gone through the greater part of the process of involution and the lower uterine segment has disappeared (*vide* Retroflexion of Uterus). The condition is discovered during the routine examination of the puerperal patient. It is very important to correct the displacement and insert a Hodge pessary, which should be worn for two months. Such treatment prevents the persistence of the displacement which, if allowed to continue, may result in progressive prolapse of the uterus.

(4) **RETROFLEXION OF THE UTERUS.**—Retroflexion is generally acquired ; rarely is it congenital. When one considers the development of the uterus from the infantile to the adult form (to which reference has already been made), and the comparative shortness and thickness of the uterine wall, one realises how unlikely it is for the body of the uterus to become bent backwards as a result of a developmental error.

The great majority of retroflexions follow parturition. During the first few days of the puerperium the uterus cannot fall backwards, because the large organ is supported by the pelvic brim. *When, however, the uterus becomes a pelvic organ, its body may readily bend unduly forwards or backwards because of the relaxed lower segment or isthmus* (p. 663). If it swings backwards and involution is completed in this position the uterus remains with the body bent sharply backwards, thus retroflexion persists. The continuous recumbent posture maintained by many patients after delivery probably favours it.

The all-important point is that it can practically always be prevented from persisting if all patients are examined vaginally between the tenth and fifteenth day, and, should a retroflexion exist or there be any suspicion of a backward displacement (version or flexion), a Hodge pessary is inserted and worn for a few months (p. 858). At the end of this time the uterus will remain in normal position, and no further treatment is necessary.

Persistence of retroflexion is associated with delayed involution and congestion. These conditions render the uterus heavy, and there is every probability it will assume a permanent position of retroflexion impossible to cure by other than surgical measures.

Symptomatology.—Cases of retrodisplacement may be divided into three clinical types, viz. :—

(a) **RETRODISPLACEMENT WITHOUT SYMPTOMS.**—Congenital retrodisplacements are generally of this type. In cases in which a retro-

displacement is discovered accidentally in a patient suffering from vague local or general disturbance, it is sometimes supposed that these symptoms are *reflex disturbances* due to the position of the uterus. This can be confirmed or refuted by replacing the uterus, inserting a well-fitting pessary and noting the effect.

(b) RETRODISPLACEMENT WITH SYMPTOMS, WHERE THE FUNDUS IS MOVABLE.—This variety is rarely encountered in nulliparous women. The usual symptoms are pelvic uneasiness and backache, menorrhagia, leucorrhœa and general malaise. In all such cases the greatest care should be taken to make certain, in the manner described above, that these symptoms are due to the retrodisplacement before operation, for if this is not done great disappointment will very naturally be felt if symptoms still persist after operation.

The pelvic uneasiness consists of a feeling of weight, "bearing down" or tiredness, and is most probably due to uterine congestion caused by subinvolution. The congestion is due more to pressure on the veins as they pass through the parametrium than to any obstruction at the point of flexion of the uterus.

The menorrhagia and leucorrhœa also are probably due to subinvolution, though they may result simply from congestion. If pain is complained of it may be referred to the sacral region or to the inside of the thighs. Backache is due to dragging on the utero-sacral ligaments, while pain down the inside of the thighs is caused by traction on the round ligaments. Pain and pelvic discomfort are more common with retroversion associated with the first degree of prolapse than with retroflexion. It is very doubtful whether pain associated with uterine displacement is ever due to pressure on pelvic nerves. In some cases a vague, dull, sickening pain is complained of. In such vaginal examination usually reveals enlarged, extremely tender ovaries lying in the pouch of Douglas; the pain probably results from those organs being pressed on by the heavy retrodisplaced uterus.

In addition to these discomforts of local origin, there may be present disorders of a general character—*e.g.* malaise, headaches, nausea and feeling of exhaustion. Such discomforts are most probably due to toxæmia, debility, excessive blood loss, chronic constipation. The extent to which patients in this category "invalid" themselves, and cut down their work or exercise, tends further to the accumulation of waste products—these general disturbances cannot be considered as mere "reflex" phenomena. While in a few cases local discomforts, such as dragging pain, may be relieved by the use of a pessary, in most instances the general symptoms will not disappear until the endometritis or subinvolution has been successfully treated, the constipation corrected, and the general physical and mental condition of the patient improved.

Differential Diagnosis.—Bimanual examination usually reveals the condition. The fundus is absent from its usual situation behind the

symphysis pubis and a swelling is found in the pouch of Douglas. To ascertain the direction of the cervix is not sufficient—the body must be palpated. In unmarried women bimanual examination per rectum is preferable to a vaginal examination, as it permits a satisfactory examination without the necessity of an anæsthetic. In cases in which the patient is very stout, there may be great difficulty in defining a swelling in the pouch of Douglas. Indeed, it may be necessary to pass a sound into the uterus, but this should only be done after the local area (vulva and vagina) is cleansed, the sound sterilised, and a careful investigation of the history of the case and preliminary vaginal examination as will ensure the exclusion of pregnancy. Again we stress the value of bimanual rectal examination.

There are several conditions which may resemble a retrodisplaced uterus and more especially a *retroflexed* uterus.

(1) *Anteflexion*.—A retroposed acutely anteflexed uterus (cochleate uterus, p. 860) may be very difficult to differentiate without an anæsthetic, especially in a nulliparous woman. Exact palpation of the anterior uterine wall, particularly of the angle between the body and cervix, is necessary to establish a diagnosis.

(2) *Fibromyomata of the Posterior Uterine Wall*.—As a rule the outline of tumour and of fundus can be defined. If the tumour is moulded on the uterus the uterine sound may be required.

(3) *Ovarian Tumour in the Pouch of Douglas*.—This tumour can be palpated as a distinct swelling apart from the uterus.

(4) *Salpingitis*.—The tubes in the quiescent stage of a pyosalpinx may resemble a retrodisplacement of the fixed type. The uterus in this condition is usually retroverted and fixed to the bilateral enlarged tubes and ovaries (p. 1035).

(5) *Retroperitoneal Tumours*.—These may be innocent—*e.g.* dermoid cyst adenoma—or malignant. Careful examination reveals the fundus distinct from the tumour.

(6) *Pelvic Hæmatocele*.—This resembles more closely retroflexion of the gravid uterus than of the non-gravid uterus. The history of the case is here of the utmost importance (p. 354). The swelling is diffuse, firm in some parts and soft in others—not firm, smooth and rounded, as is the fundus of the uterus.

(7) *Pelvic Cellulitis*.—The history is important—recent labour, abortion or operation on the uterus, followed by a rise in pulse and temperature. The swelling is usually lateral and is diffuse and hard, unless it has reached the stage of abscess formation (p. 1046).

(8) *Fæcal Accumulation*.—This may give rise to confusion, but the mass in this case pits on pressure.

(9) *Appendix Abscess*.—Such a condition, when it occurs in the pouch of Douglas, resembles a pyosalpinx rather than a retrodisplaced uterus. In obscure cases examination under an anæsthetic and the help of a uterine sound may be necessary to establish a diagnosis.

In cases of this type the body of the uterus is often retroverted and fixed.

(10) *Diverticulitis*.—This condition is relatively rarely encountered in young women. It more closely resembles a carcinoma of ovary or of the sigmoid. A barium enema clears up the diagnosis (p. 1041).

(11) *Carcinoma of the Rectum*.—Rectal examination usually reveals the condition, though in some cases the proctoscope may be required.

(12) *Prolapsed Kidney in the Pouch of Douglas*.—This very rare condition can be differentiated by careful examination, under an anæsthetic if necessary, and by radiography.

(c) **RETRODISPLACEMENT WITH SYMPTOMS, WHERE THE FUNDUS IS LESS OR MORE FIXED**.—Fixation of the retroverted or retroflexed uterus is due to the presence of adhesions or to the pressure of a tumour. The adhesions usually result from some inflammatory process originating in the uterus itself, the tubes, the appendix or the rectum—they are the end results of an old pelvic peritonitis. This variety is usually associated with chronic ill-health, pelvic discomfort, premenstrual pain, menorrhagia, leucorrhœa and recurrent attacks of pain in the lower abdomen, all symptomatic of chronic pelvic inflammation.

The diagnosis is usually easy : the position of the uterus is recognised more commonly in retroversion than in retroflexion. The swelling in the pouch of Douglas may be uniform and smooth, but where there is enlargement of the tubes and ovaries it is usually irregular. An attempt to push up the fundus causes pain, more especially during the congestive or premenstrual phase of the menstrual cycle. For the exact diagnosis an anæsthetic is often necessary ; *and by a bimanual rectal examination one can often define the fundus and adnexa more exactly than by a bimanual vaginal examination (vide p. 114).*

Treatment of Backward Displacement in its Different Forms.—

(a) **PREVENTIVE TREATMENT**.—Reference has been made to the correction of retrodisplacement in the puerperium (p. 663). Such treatment should be employed within twenty days from parturition ; at a later date results are not so good.

It is often stated that a retroflexion, congenital or acquired, may be cured if following on a subsequent pregnancy the uterus is replaced and a pessary inserted—in our experience success results in a very limited number of such cases ; hence the enormous importance of correcting any displacement in the puerperium during which the displacement occurred.

(b) **BACKWARD DISPLACEMENTS IN THE UNMARRIED**.—In the absence of symptoms no treatment is necessary. Where symptoms are present, no local treatment should be employed until every step has been taken to exclude other lesions as the cause of the patient's discomfort ; this done, the position of the uterus should be corrected and a pessary inserted. If menorrhagia or leucorrhœa is present, it is advisable to curette the uterus at the same time. The pessary

should be changed regularly at three-monthly intervals and worn for one year; it should then be removed. If the patient remains free from symptoms no further treatment is necessary, but she should be required to report herself once a year. If the symptoms recur, the displacement should be permanently corrected by surgical means (Chapter LVI).

(c) **BACKWARD DISPLACEMENTS IN MARRIED WOMEN.**—Here, again, it is only the presence of symptoms which have not responded to other forms of treatment that warrants local treatment.

If treatment is necessary, the displacement should be corrected and a pessary inserted. Occasionally this is sufficient, but if it is not, the uterus should be curetted and a pessary worn for a year. If the uterus again becomes retrodisplaced after removal of the pessary, surgical treatment should be employed. If a woman with a retrodisplacement remains sterile for several months after marriage (and contraceptive measures have not been employed), the displacement should be corrected and a pessary inserted, whether symptoms are present or not, as in some instances pregnancy follows replacement (*vide* p. 819).

If pregnancy occurs in a patient with a retrodisplacement, it should be corrected and a pessary inserted, as retroflexion more especially predisposes to abortion (p. 323). The pessary should be removed at the end of the fourth month.

(d) **FIXED BACKWARD DISPLACEMENTS.**—As a rule surgical treatment is required. Palliative treatment is only of value in fairly recent cases. Hot douches, vaginal tampons soaked in glycerine and radiation may effect a recovery from a recent inflammatory process to such an extent that uterine mobility is re-established. When mobility is established the displacement may be corrected and a pessary inserted in the hope of establishing a permanent cure.

When the abdomen has to be opened for chronically inflamed tubes, ovaries or appendix, it may be necessary to stitch the uterus to the abdominal wall. The round ligament operations, so useful for movable backward displacements, are of little value if the uterus is fixed unless the adhesions are slight and easily separated (*vide* Chapter LVI).

REPLACEMENT OF A MOBILE BACKWARD DISPLACEMENT.—Replacement may be carried out either manually or by the aid of the uterine sound; the former method is *préférable*. There are many cases in which reposition cannot be effected manually until the patient has been anæsthetised; particularly does this apply to patients with sensitive or thick abdominal walls. Occasionally, especially in retroflexion of the gravid uterus (p. 287), the exaggerated left lateral position (Sims' position) or the genupectoral position renders correction easier.

The ordinary bimanual method is carried out with the patient on her back (Fig. 343 (1)). Two fingers in the vagina push up the fundus from the posterior fornix, while the fingers of the external hand, pushed

down into the pelvis close by the sacrum (Fig. 343 (2)), pull the fundus upwards and forwards. With the fundus raised, correction is completed by slipping the vaginal fingers from the posterior into the anterior fornix and pushing the cervix backwards and upwards (Fig. 343 (3)). Should these manipulations fail, the insertion of a pessary and using it as a lever to lift up the fundus may be helpful in the case of retroversion, but is seldom of much use in the case of retroflexion. Another manœuvre is to grasp the cervix with volsella and pull slightly down-

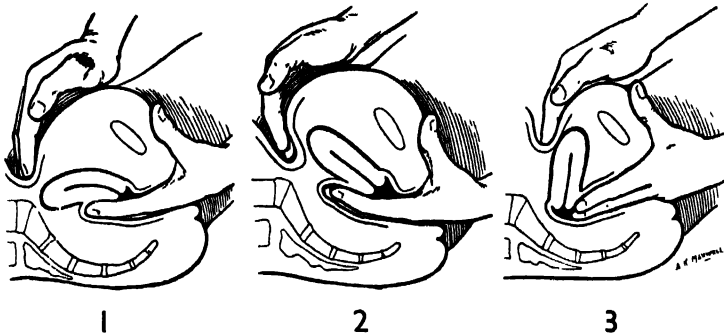


FIG. 343.—Bimanual Replacement of Retrodisplacement.

Note how operator in 3 has moved his finger from posterior into anterior fornix and is pushing cervix backwards.

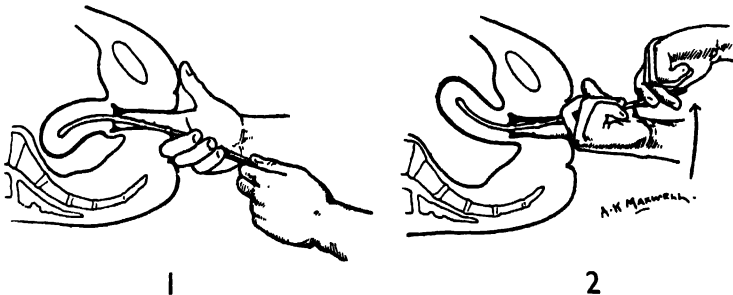


FIG. 344.—Replacing a Retroflexion with Uterine Sound.

Note arrow in 2 indicating wide sweep of handle of Sound (*tour de maître*).

wards, while the fundus is pressed upwards by the fingers in the posterior fornix. The manœuvre is completed by pushing the volsella and the cervix backwards and upwards as the fundus rises—here again the manipulations are more successful in retroversion than in retroflexion and in theory than in practice.

Where the above methods fail, the fundus may be raised by means of the uterine sound (Fig. 344). *The point of the sound is directed forwards in retroversion, backwards in retroflexion.* The sound is guided into the uterus by two fingers in the vagina, and, if the condition is a retroversion, the fundus is gently raised by the sound and the fingers in the posterior fornix. If the displacement is a retroflexion a wide sweep of the handle must be made, so as to turn the fundus round

into a forward position (*tour de maître*) (Fig. 344 (2)). When the sound is removed, a pessary is inserted.

The uterine sound is seldom employed by the modern gynæcologist in his consulting room. If an exact diagnosis, or replacement of uterus, cannot be made by the ordinary bimanual methods, he prefers to have the patient anæsthetised, when the pelvis can be more completely examined and the vagina thoroughly disinfected prior to the introduction of the sound into the cavity of the uterus.

CHOICE AND INTRODUCTION OF A PESSARY.—To gauge the size of the pessary required, a finger is passed into the posterior fornix and

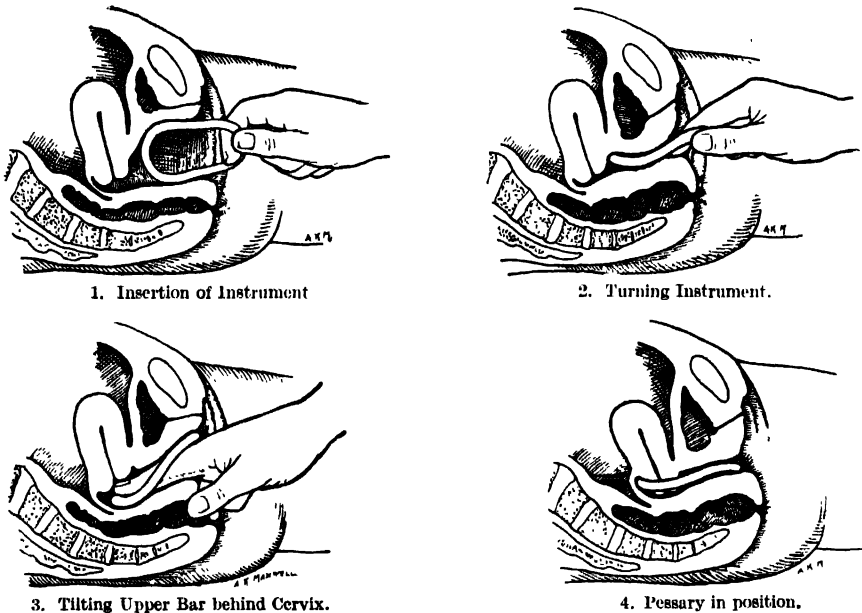


FIG. 345.—Method of inserting an Albert Smith Pessary.

the length of the vagina measured. A Hodge pessary (Fig. 340 (1)) is most convenient, but where the vaginal vault is capacious (multipara) an Albert Smith pessary (Fig. 345) in which the upper part is wider is sometimes better. It is quite easy, by the use of boiling water, to mould a celluloid pessary to suit any particular case. The Thomas pessary, with its thickened upper bar, fills up the vaginal vault and prevents the ovaries being pressed upon if they are prolapsed. The smallest pessary which will maintain the uterus in position should be selected. *With the instrument in position there should be just enough room to insert the tip of the finger between the lower bar and the back of the symphysis pubis; and, when the instrument fits well, the patient should be unaware of its presence.*

The pessary is introduced as shown in Fig. 345. The instrument is inserted with its transverse axis in the long axis of the vaginal opening; when inside the vaginal canal it is turned to lie horizontally, with

the upper bar directed towards the vaginal vault. Then one finger is inserted into the vagina, underneath the pessary, when it will be found that the upper bar lies in the anterior fornix—this bar should now be depressed and placed in its proper position in the posterior fornix.

While wearing a pessary the patient should be instructed to douche the vagina daily. The pessary should be changed every two months. The patient should report to her physician if she feels any local discomfort. No veto need be placed on ordinary work, exercise or coitus for a patient wearing a well-fitting pessary. If complete local comfort cannot be secured, pessary treatment should not be persisted in.

Retroversion and Retroflexion of the Gravid Uterus.—This subject has been dealt with elsewhere (p. 287).

FORWARD DISPLACEMENTS OF THE UTERUS— ANTEFLEXION AND ANTEVERSION

Anteflexion.—The normal uterus is anteverted and slightly anteflexed. In the cases referred to here, the anteflexion is very much exaggerated. The term “displacement” is quite wrongly applied to this abnormality of the uterus—it is a malformation or error in development. It may be associated with definite symptoms; on the other hand, it may be accidentally discovered in women who have never had disturbing symptoms.

ÆTIOLOGY.—Acute anteflexion, apart from pregnancy (p. 286), is a developmental error; it arises, as a rule, as the uterus changes from the infantile to adult type before puberty (p. 99). For purposes of classification we may distinguish: (1) cases in which the body of the uterus is of normal size; and (2) cases in which there is underdevelopment of the uterus.

In the first form (Fig. 346 (2)) the body is acutely bent on the cervix, but the position of the uterus as a whole is not altered. This variety of flexion is quite within normal limits. In the second variety (Fig. 346 (3)) the uterus is definitely underdeveloped. It was customary in the past to describe it as a “retroverted anteflexed uterus,” but to-day it is generally referred to as the *cochleate uterus*, which is an excellent description of its shape.

CLINICAL FEATURES.—Symptoms, if present in a case of anteflexion, are due to the associated irregularity in the development of the uterine wall rather than to the flexion of the uterus. Some gynæcologists maintain that acute anteflexion *per se* does not produce symptoms, but this opinion is not universally accepted. *The condition and associated symptoms are encountered only in nulliparous women. They very rarely indeed recur after a pregnancy.*

The symptoms are the same, but of different degree, in the two types described. In the type where the uterus is of ordinary size there may be dysmenorrhœa, but the periods are of normal duration.

Besides, sterility is not necessarily a feature. The condition is amenable to treatment; indeed, in a large proportion of cases no treatment is necessary. In the other type with marked underdevelopment, dysmenorrhœa, scanty periods and very often incurable sterility are the features.

The dysmenorrhœa is most pronounced during the first few hours of the flow, and disappears after the first twenty-four or thirty-six hours. In cases of marked underdevelopment the dysmenorrhœa may be extreme and the flow scanty. The cause of the dysmenorrhœa in such cases has been discussed in Chapter XLIII, p. 801. It is most probably due to irregular contraction of the uterine musculature and

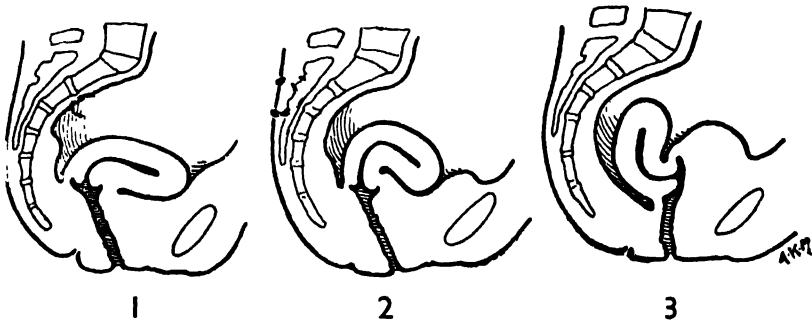


FIG. 346.—Varieties of Anteversion and Antelexion.

1. Antelexion. 2. Slightly exaggerated Antelexion. 3. Extensive Antelexion (cochleate uterus).

hormonal disharmony. It may be due in part to slight interference with discharge of blood through the cervix, caused not so much by the bend in the canal as by the menstrual congestion of the endometrium obstructing the narrow canal. Most women with antelexion enjoy excellent health in the intervals between menstruation; but a few suffer from minor degrees of ill-health, with nervous irritability, caused by the depressing effect of recurrent attacks of *dysmenorrhœa*; and the married from disappointment at persisting *sterility*.

DIAGNOSIS.—The condition is seldom difficult to diagnose except in so far that examination *per vaginam* is often difficult because the patient is practically always a nullipara. Few conditions resemble an acutely antelexed uterus. Where it is a question of antelexion or a small fibroid of the anterior wall of the uterus, the uterine sound may be required to establish a diagnosis. Care should be taken to exclude an early pregnancy, in which condition acute antelexion is sometimes very pronounced (p. 165).

The retroverted cochleate uterus may be mistaken for an uncomplicated congenital retroversion until the acute flexion of the anterior uterine wall is determined (p. 854).

TREATMENT.—(a) *Acute Antelexion where the Uterus is of Normal Size.*—In the unmarried treatment is required only if dysmenorrhœa

is pronounced. Simple dilatation should be tried as a first measure ; *curettage should not be performed in the first instance*. In the married, if there is a persistence of sterility, it may be advisable to remove a few pieces of endometrium by curette immediately before the menstrual flow in order to determine to what extent the endometrium is taking on the necessary development characteristic of the premenstrual phase of the cycle, so essential for satisfactory imbedding of the zygote.

Simple dilatation usually relieves the dysmenorrhœa temporarily, and in the married may permit pregnancy to occur. If dysmenorrhœa returns after dilatation, the latter may be repeated. Treatment of dysmenorrhœa and sterility by hormones are discussed in Chapter XLIII.

Few now favour the employment of a stem pessary because of the risks of infection, but reference must be made to it as there are still gynæcologists who employ it when all other methods of treatment have failed to relieve the dysmenorrhœa and/or sterility. Several varieties exist—one is here shown, "Wylie's drain" (Fig. 347). This pessary is introduced into the uterus under an anæsthetic at the end of a period, and removed when the next period becomes due. The stem must be of the proper length for the uterine cavity, and be retained in position by a Hodge pessary, as the stem would otherwise be expelled by the uterine contractions. Only gentle exercise should be allowed, and intercourse forbidden while it is worn. The pessary straightens out the uterine canal. It should not be worn for more than two to three menstrual intervals, and should be removed prior to the onset of the period.

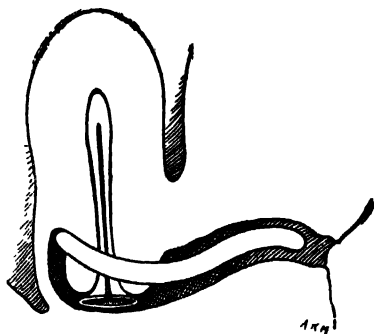


FIG. 347.—Showing "Wylie's Drain" or Stem in Uterus, and Hodge Pessary in position. The stem is made of vulcanite, and as shown has a gutter along its length.

Operations have been recommended in which the posterior lip of the cervix or the fibres of the internal sphincter are incised. The value of such operations is doubtful.

(b) *Acute Antelexion associated with Marked Underdevelopment of the Uterus*.—In cases of this type the prognosis is extremely unfavourable both as regards dysmenorrhœa and sterility. In some cases, where the hypoplasia is not very marked, improvement may result from treatment with hormones—stimulation of ovaries by mild dosage of X-rays is very risky. In the grosser forms, dilatation gives only temporary relief to the dysmenorrhœa. In the worst cases of pronounced underdevelopment of the uterus, if dysmenorrhœa is extreme the most satisfactory treatment is hysterectomy. This is

preferable to bringing on a menopause by means of radium or X-rays which may destroy entirely ovarian function.

Anteversion.—This position is normal. Very occasionally (Fig. 348), however, cases are encountered in which the body of the uterus is enlarged, hard and straight, due to chronic metritis or subinvolution. The symptoms are those of subinvolution—excessive menstrual periods, leucorrhœa and a feeling of weight in the pelvis. The pressure of the fundus on the bladder may cause discomfort and frequency of micturition, but the possibility of an associated cystitis should not be overlooked.

The condition requiring treatment here is the chronic metritis or subinvolution. Pessaries are of no value. When the bladder discomfort

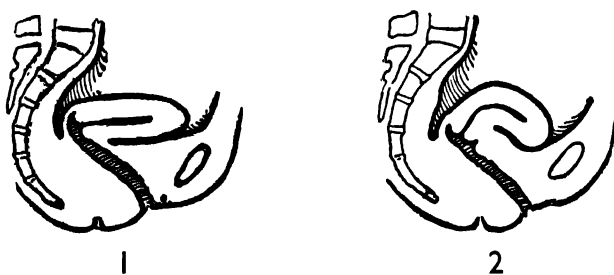


FIG. 348.—Showing Anteversion (1) in contrast to Anteflexion (2).

is persistent and no cystitis is present it may be advisable to perform ventrofixation and secure the uterus very firmly to the abdominal wall. In women over forty hysterectomy is the better procedure.

LATERAL DISPLACEMENTS

We have already seen that lateral displacement of the uterus is a not uncommon occurrence in pregnancy, and may give rise to symptoms simulating ectopic pregnancy (p. 352).

In the non-gravid, lateral displacements of the fundus usually result from pressure by a tumour or traction by cicatrised tissue. In a pelvic cellulitis the uterus may be pushed to one side in the acute stage by the effusion and drawn to the other side later by cicatrification. In these cases it is the tumour or the inflammatory process which causes the symptoms which requires treatment.

INVERSION OF THE UTERUS

This condition, in which the uterus is turned inside out, has come to be considered with displacements of the uterus. It occurs most frequently during the third stage of labour and, if discovered then, as is usually the case, it is termed *acute inversion* (p. 568). In a few cases, however, the complication escapes notice at the time and is discovered later, when it is described as *chronic inversion*.

Very occasionally inversion may occur apart from pregnancy if

a fibromyoma, growing from the fundus of uterus, is driven through the cervix and drags the fundus with it.

Chronic Puerperal Inversion.—In this rare complication the uterus involutes in its inverted position, but it remains in the vagina as a soft swelling, which bleeds readily to touch and shows areas of superficial ulceration (Fig. 349). Its surface is somewhat darker in colour than the vaginal mucous membrane; in old-standing cases the columnar epithelium of the uterine wall may become converted into a stratified squamous epithelium.

Sometimes one or both tubes and ovaries are dragged into the inverted sac (*vide* Fig. 234, p. 569). If infection of endometrium spreads to the peritoneal surface of the uterus, the inner walls of the sac, tubes and ovaries may become sealed together, thereby preventing reduction. There have been cases recorded of intestinal obstruction caused by this condition; but a loop of intestine is very seldom found in the sac except immediately after the occurrence of the inversion.

The patient complains of irregular bleeding and a mucoserous or muco-purulent vaginal discharge. She has a feeling of "bearing down," and may complain of something "coming down." The hæmorrhage and the chronic infection lead to general ill-health.

DIAGNOSIS.—On examination a large globular body is found in the vagina. Above the swelling the ring of the cervix is usually felt, though in a few cases the cervix also is inverted. A very important sign is the identification through the abdominal wall of the cup-shaped depression, which represents the ring through which the fundus has descended. An anæsthetic may be required before this diagnostic feature can be determined.

The only condition which simulates inversion is a fibroid polypus projecting through the cervix. Here, however, the fundus of the uterus can be felt above, and the stalk of the polypus can be made out passing through the cervical canal. If there should still be any doubt, the uterine sound could be passed alongside the stalk into the

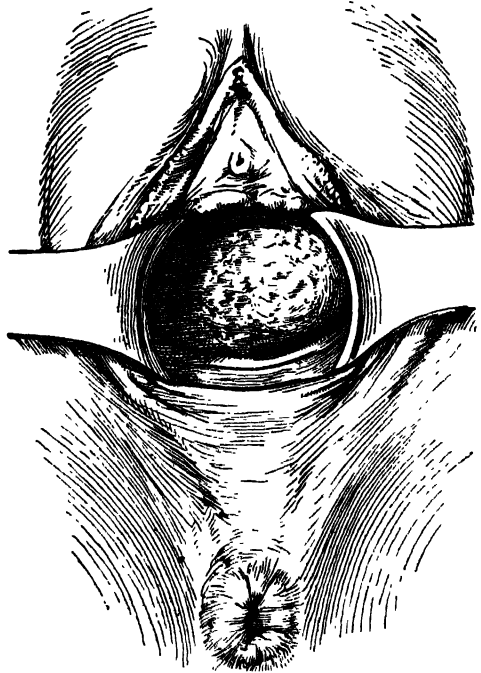


Fig. 349.—Chronic Inversion of Uterus as seen from the Vagina.

cavity of the uterus, whereas it would be arrested just inside the cervix in a case of inversion.

TREATMENT.—In this variety (chronic inversion) the stage has passed at which immediate replacement by taxis, even under an anæsthetic, may be hoped for (p. 568). There have been, however, a number of cases recorded in which spontaneous rectification has occurred after a course of hot antiseptic douches. This, therefore, should be given a trial prior to the employment of Aveling's repositor (Fig. 350).

The figure on the right shows Aveling's repositor in position. The most dependent part of the uterine wall is supported on a cup, which

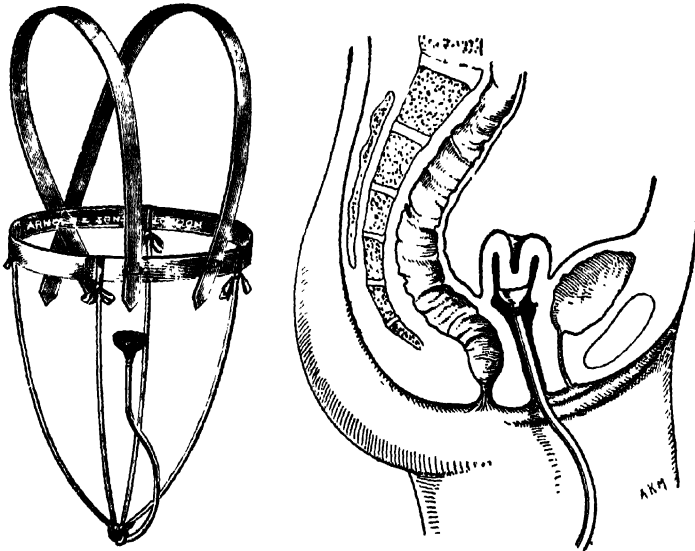


FIG. 350.—Uterine Repositor (Aveling's) with Straps and Waistband.

should not be too small. The one selected should be of a size to cover sufficient surface for the purpose of pressure, but not so large as to make it difficult to extract through the cervix. This instrument may cause the patient pain. It can seldom be borne for more than an hour or two at a time—the patient should be kept lightly under the influence of morphia.

When these methods fail, rectification should be secured by surgical means, described in Chapter LVI.

Inversion associated with Submucous Fibroid.—In such cases the diagnosis of the presence of the tumour is not difficult, *but, on the other hand, the associated inversion may be missed.* The cup-shaped depression above may be difficult to identify, because comparatively little of the fundus may have passed through the cervix. As a rule the surface of the tumour and the vaginal canal are very septic, and the uterine wall at the seat of the growth is usually very thin. A

portion of the tumour tissue should always be sent for examination, as it has been remarked that a number of these tumours show signs of malignant degeneration (sarcoma) !

Great care should be taken in the enucleation of the tumour (myomectomy) because of the thinness of the uterine wall and the risk of sepsis. Thorough pre-operative cleansing is necessary. When the tumour is removed, the fundus usually returns spontaneously to its proper position. The uterus may be packed with gauze. Pituitrin or ergot should be given. There is very great risk to the patient if the uterine wall should happen to be perforated during the operation, because of the septic condition present. If the reposition of the fundus does not occur spontaneously no attempt should be made to reduce it forcibly at the time of operation. In patients over forty, and in some younger women, the safest treatment may be hysterectomy.

UPWARD DISPLACEMENTS

The uterus is raised upwards from the third month of pregnancy onwards.

Pelvic tumours may push the uterus up out of the pelvis (cervical fibroid), or abdominal tumours (*e.g.* sessile ovarian cysts) may drag it upwards. A pelvic hæmatocele or a pelvic peritonitis may be associated with sufficient effusion to raise the uterus above its normal level. In these conditions the position of the uterus is of relatively little importance ; it is the condition causing the symptoms which requires consideration and treatment.

SUMMARY

During the last fifty years gynæcological opinion regarding the significance of uterine displacements has, pendulum like, swung from one extreme to the other. In the earlier days of gynæcology great importance was attached to uterine displacements, and many and varied mechanical devices were employed to correct them. To-day some extremists would have us believe that variations in flexion and version of the uterus are of no significance whatsoever. Neither extreme is justified. It is of primary importance to maintain a balanced view on the subject. Briefly it may be stated thus—never attribute the symptoms complained of to a flexion or version of the uterus unless other possible causes (medical and surgical) have been excluded.

CHAPTER XLV

INFECTIONS OF THE REPRODUCTIVE ORGANS

Puerperal, Gonorrhœal, Syphilitic, Tuberculous, Parasitic, etc.

GENERAL CONSIDERATIONS

THE vaginal canal in the newborn female child is sterile except in some cases of protracted breech presentation. In a comparatively short time after birth, however, it becomes invaded by a variety of organisms which extend up to the cervix uteri; and so it remains during life. In the healthy woman the canal above this point should not contain organisms of any kind. There is no actual physical barrier to prevent entrance of organisms into the uterine cavity by *continuity of tissue from below*; but certain circumstances combine to make such entrance difficult. The canal may be invaded from above, however, *by blood-borne infections*, particularly of the tuberculous type, while many adnexal infections in the puerperium arise *by a lymphatic spread* from a lacerated vagina or cervix rather than by continuity of tissue, which is the mode of extension in gonorrhœal infection.

The vaginal canal in the healthy woman between puberty and the menopause contains a great variety of organisms, but these are ordinarily innocuous, largely on account of the presence of the bacillus of Döderlein—a large rod-shaped bacillus which, being an acidophil organism, maintains an acid vaginal secretion. This is the process—
(a) the oestrogenic hormone of the ovary which influences the periodic laying down of glycogen in the epithelial cells of cervix and vagina;
(b) Döderlein's bacillus effects production of lactic acid by causing fermentation into glucose of the glycogen laid down.

For a short time (two to three weeks) after birth, the vaginal reaction is acid, and the Döderlein bacillus is present owing to the influence of œstrin in the infant's body obtained from the mother prior to its birth. When this hormone is completely excreted by the infant, the reaction becomes alkaline and remains so until puberty is reached—during these years the Döderlein bacillus is absent. After the menopause œstrin influence fades and again the Döderlein bacillus disappears, with the result that the vaginal canal returns once more to a condition in which infection is more likely to arise. This explains the susceptibility of elderly women to senile vaginitis and endometritis (p. 917).

At certain epochs the vaginal reaction is altered. The discharge of

blood through the canal during menstruation, at the end of labour, and in the puerperium lowers the acidity: we have confirmation of the importance of this change in the fact that infection of the uterine cavity occurs most frequently at these times.

In pregnancy, as we have seen, the acidity of the secretion is raised and in addition the uterine cavity is protected by the mucous plug or *operculum* which closes the canal very completely, especially in primigravidæ. When this plug is examined, its outer third is found to contain a variety of organisms, its middle third very few, while its inner or upper third is sterile.

Certain general and local conditions permit infection of the vagina and extension to the upper portion of the reproductive canal, either by allowing their direct entrance or by lessening the protective action of the vagina. As regards general conditions, mention may be made of general health, and disturbed "hormonal balance." We need not, however, pursue this aspect of the subject further, as full reference is made to it under Leucorrhœa (p. 794). Turning now to local favouring factors, mention may be made of sexual intercourse, vaginal douching, wearing of a pessary and patency of the canal when the perineum is deficient.

The character of the walls in the various parts of the reproductive canal is important in determining the actual sites at which infective lesions usually become established. The *area of the vulva*, with its sebaceous glands, its urethral opening, the Skene's tubes, the little crypts in the mucous membrane near the urethra, and the orifices of the glands of Bartholin, may very easily become the seat of infective lesions. The *vaginal canal*, covered with stratified squamous epithelium, which extends from the vulva right up to the external os, without any glands opening on its surface, is very resistant to infection, so long as its surface remains intact. The *cervical canal*, with its deeply penetrating compound racemose glands, is a most favourable site for the growth of organisms, and once an infective process becomes established there, its eradication may be singularly difficult. The uppermost portion of the tract, the *uterine and tubal mucous membranes*, are normally sterile surfaces, but are very susceptible to infective processes.

Some of the campaign against venereal disease has left, even among doctors, the impression that most of the infective lesions in women are of gonorrhœal origin. How far this is from the truth is seen from the records of unselected cases seeking treatment for gynæcological conditions, in which the lesion present is of inflammatory origin. Between 60 to 70 per cent. of these cases result from infections arising during labour and the puerperium—many follow a septic abortion. The relative proportion of infections of puerperal and of gonorrhœal incidence is influenced by several factors—*e.g.* race, residence (urban or rural), social customs, mode of life, etc. Thirty to forty per cent. are of pure gonorrhœal origin, and approximately

5 per cent. are of tuberculous origin; the remainder include cases associated with bowel lesions, such as appendicitis and diverticulitis, and also accidental infections in young virgins. These different types will be considered separately. Puerperal and gonorrhœal infections are of the ascending variety—the tuberculous variety is usually hæmatogenous. The others included spread from tissue to tissue by the blood-stream or by the lymphatic stream.

While syphilis is a most potent disease, its manifestations in the female reproductive tract are trifling compared with its danger to the tissues of the whole body. Severe gonorrhœal infection if not arrested does much more local injury than does syphilis.

PUERPERAL (INCLUDING ABORTION) INFECTIONS

Acute lesions of this type have been described in Chapter XXXVII as complications of the puerperium. Those which give rise to chronic conditions are considered with the special organs or tissues concerned, such as uterus, Fallopian tubes, ovary, or pelvic cellular tissue, and are summarised in Chapter LII, p. 1040.

GONORRHOËAL INFECTIONS

Gonorrhœa is confined in its manifestations chiefly to the reproductive canal and entrance of urethra. Infection of rectum is a rarity (p. 873). In a few cases, the organism may be accidentally inoculated on the conjunctiva. Invasion of the blood-stream by the diplococcus and acute or subacute infection of joints is not uncommon.

The cultivation of the gonococcus from even active lesions is often difficult. It may be preserved for a few days under the most favourable conditions—namely, a temperature of about 37° C. in a moist medium. The cultural media must be alkaline. It is difficult to obtain the organism in secretions for microscopic diagnosis. Vaginal secretion, except in children, is of no value. *The best site from which to obtain pus for examination is the urethra*, which is practically always involved, but even there the organisms may be swept away by the urine. The patient should therefore be instructed to avoid passing urine for three or four hours before examination. In some cases material may be taken from the cervix uteri, another favourite resting-place of the organism; but it is only when the surface of the cervical canal has been wiped to clear away other organisms and its depth has been well cleansed with a covered probe that the gonococcus can be found. A smear preparation is then made, dried and stained.

Course of the Infection.—The conditions under which this organism flourishes are so unique that it is only rarely found in any other tissue than the genital tract, and its spread in most cases is dependent upon sexual intercourse. The organism may be transmitted from either an acute, a chronic, or a recurrent infection in the male.

In the *chronic case*, or the case which has been thought to be cured, the organism will usually be transferred with the semen, and is most likely to cause a cervical lesion; in the *acute case*, with purulent discharge left on the vulva, primary lesions in both areas may develop. Accidental infections occur, in a small number of cases, as the result of the use of infected towels or linen, unclean water-closet seats, unclean douche nozzles or other instruments, and may occur from inoculation by the hands.

For reasons already given the vaginal mucous membrane is fairly resistant to the gonococcus; it is most likely to be involved in young girls or during menstruation, or shortly after that event. The areas most susceptible to inoculation are the vulva and the cervical canal. Beginning with a superficial spread associated with a local hyperæmia, the organisms soon penetrate inwards between the separated epithelial cells and lodge in the submucous tissues, or in the case of the cervix in the depths of the glands. A local vascular reaction follows—the smaller vessels become engorged and crowded with leucocytes; emigration and phagocytosis occur, and a purulent discharge appears.

The infection may spread by continuity of tissue, not only into the cavity of the uterus but also to the Fallopian tubes. In only a small number of cases does the infection spread to the peritoneum. In any closed cavity, such as a sealed Fallopian tube or a gland with an occluded duct, the life of the gonococcus is very limited. The organisms may multiply very rapidly to begin with, and form a considerable collection of pus; but they are very soon killed by the products of their own metabolism—in a few weeks the cavity will be found to contain a collection of quite sterile pus. On the other hand, if there is any drainage from the sac, the organisms may continue to thrive: an abscess under these conditions may continue to grow so large as to be a source of danger and require special treatment.

Unfortunately, gonococcal lesions very soon have implanted on them a growth of streptococci, staphylococci, B. coli, or diphtheroid bacilli, which added factor is in most cases responsible for the permanent tissue damage resulting from gonorrhœal infections.

In the main, gonorrhœal lesions have a tendency to remissions; but the patient is in only a few cases completely cured by this means, because the organisms have a tendency to hide in some recess, where they lead a subdued existence, but from which a recrudescence may at any time flare up. In the female there are many such lurking places—*e.g.*, the cervical canal, the glands of Bartholin, Skene's ducts, and even the urethra itself. In a few cases the infection spreads from the urethra to the bladder and thence to the pelvis of the kidney. Occasionally the organisms spread to the blood-stream, and distant lesions occur—joints are specially prone to be affected.

Symptoms.—The early symptoms may be very slight and cause little disturbance. In young girls, where the local resistance is so

much less, there may be a very acute inflammatory reaction, causing considerable general disturbances. The nature and virulence of the infection in pregnant women has been referred to (p. 281).

The *cervix is the chief site of infection in adults*. Even where the urethra has been the seat of the primary lesion, the cervix is usually soon involved. In the acute stage it is tender to touch, presents the appearance of an acute catarrhal condition, and pus is seen exuding from the external os. The vaginal canal is seldom the seat of a severe lesion in the adult; but as the activity of the vaginal bacillus is inhibited and the acidity of the secretion reduced, there may be some redness of the mucous membrane due to the irritating effect of the cervical discharge.

The *vulva* also shows a reaction to the cervical discharge and may become oedematous. This is specially so in the labia minora. The sebaceous glands on the inner surface may become infected; they appear as reddened patches with purulent secretion, projecting beyond the surface. All the side-pockets and crypts in the mucous membrane are possible seats of infection. The openings of the glands of Bartholin appear in most cases as raised red spots near the fourchette.

The *urethra* is affected, either primarily or secondarily, in 80 per cent. of cases, though the urethritis may cause little discomfort. There is seldom difficulty or pain on micturition, even when the mucous membrane is swollen and everted, and pus exudes from the canal. The urethra is painful on pressure. Even in the acute phase the patient may be kept fairly comfortable by frequent micturition washing out the urethra. In more chronic cases there may be no appearance of urethritis, but in such cases a little pus may be obtained by passing one finger into the vagina and "milking" the urethra downwards along the back of the symphysis pubis.

Treatment.—As gonorrhœa is usually a local infection of the reproductive canal, local treatment is of the greatest importance; but the internal administration of sulphonamide has recently been shown to have considerable value in controlling the duration of infectivity.

Extreme cleanliness must be observed in the carrying out of all treatment, and the patient should be instructed to keep all her towels and linen for her own use. Sanitary towels should be worn to protect the clothing. Sitz baths, containing some antiseptic like creolin or potassium permanganate, should be used several times daily in the acute stage and at least once daily in the chronic stage. Once daily each infected area of the *external genitalia* should be very carefully cleansed with dry swabs. In certain cases it may be necessary to treat an infected area with a 3 to 5 per cent. solution of silver nitrate (or some other silver solution of equivalent strength), mercurochrome or violet green, the solution being applied on probes covered with cotton-wool. Where there is an abscess of Bartholin's gland, it should be aspirated and a weak solution of silver injected.

In recent years meticulous disinfection of infected areas with germicides has been replaced in great part by treatment with sulphanilamide (p. 653), sulphathiazole (Thiazamide) M & B 760 or sulphapyridine M & B 693—the first is claimed to cause less gastric upset.

The *urethra* may require treatment by washing out with a solution of 1 in 2000 silver nitrate—the lavage to be repeated several times at each sitting—or by the direct application of a 2 per cent. solution of silver protein salt, by means of a probe wrapped with cotton-wool, to practically the whole length of the urethra, but not quite up to its inner end.

With treatment by sulphanilamide and kindred drugs the best results appear to be obtained by daily local dry swabbing of the parts only; special care being given to the fornices and leaving all parts dry. Antiseptics tend to leave a residual “non-gonococcal” discharge. Douching, unless other local treatment is impracticable, is not very satisfactory.

Sulphonamides should not be administered until films or cultures from the cervix, urethra or other foci have confirmed the suspected presence of gonococci. Sulphapyridine (M & B 693) is the most therapeutically efficient compound and should be employed in a dosage of 1 gm. at regular eight-hourly intervals for seven days.

A coexisting infection with *Trichomonas vaginalis* should be controlled by the daily local application of two stovarsol tablets into the posterior fornix.

In occasional resistant cases, local treatment should be maintained and a further similar course of sulphapyridine after fourteen days may give satisfactory results. In chronic cases, intradermal injections of minimal doses of mixed gonococcal vaccine at five-day intervals for a few weeks before sulphonamide therapy are often helpful.

Before a case can be considered cured, the genital tract should have regained its normal appearance, no purulent discharge or areas of redness should exist on the vulva or cervix, and no gonococci should be found on smears which have been prepared with the greatest care. Examination near a menstrual period is more likely to secure gonococci than at other times. This complete negative report should be obtained on at least three occasions (after the menstrual periods) before the patient is pronounced free from the disease. A complement-fixation test should be made to confirm that complete cure has been established.

Complications of Gonorrhoeal Infection.—It is very important to clear out all the gonorrhoeal foci, as there is always the risk of some organisms escaping into the blood-stream and setting up an arthritis, an iritis, or even an endocarditis.

Cystitis.—While a slight amount of pus appears in the urine as a result of the urethritis, a considerable pyuria usually indicates a cystitis. This can be demonstrated by getting the patient to pass

urine in two portions, the first part of which will contain pus from the urethra, while that in the second specimen comes from the bladder.

The bladder should be washed out with a 1 in 8000 solution of potassium permanganate, or a 1 in 4000 solution of acriflavine in normal saline. This should be combined with the administration of sulphapyridine and an alkaline mixture (sodæ bicarb., 10 to 20 gr., half-hourly dose of M & B 693).

Extension to the pelvis of the kidney is an unusual occurrence, and may require the injection of acriflavine into the ureters.

Gonorrhœal Warts.—Warty excrescences, described as “*Condylomata Acuminata*,” may appear on the vulva and round the anus. In women

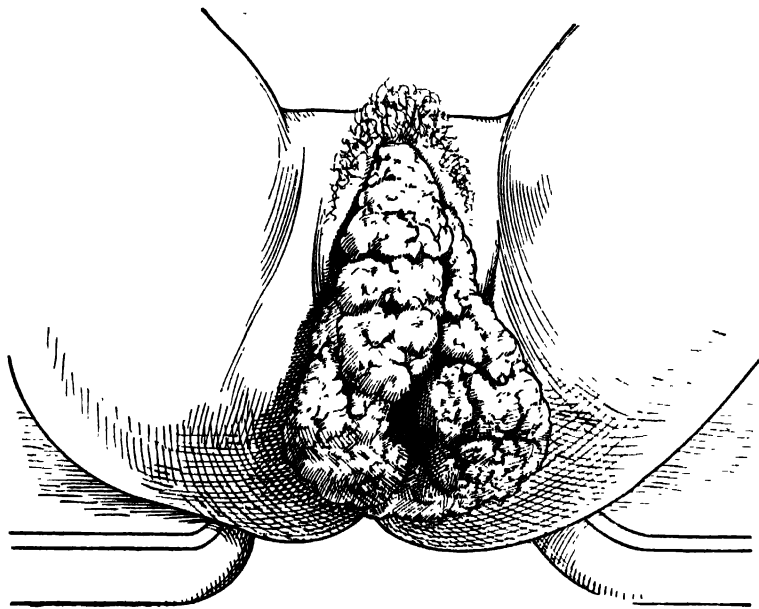


FIG. 351.—“*Condylomata Acuminata*.”

of unclean habits these may form huge vegetating masses, growing in a short time to the bulk of a small-sized cauliflower (Fig. 351). The growth is particularly rapid and extensive in pregnant women of this class. No gonococci can be identified in the tissues of the mass; there are only elongated branching epidermal papillæ with thickened epithelium. These growths, however, are always associated with chronic gonococcal lesions. The surface tends to slough, and a copious, often blood-stained, discharge pours from the surface.

Frequent antiseptic sitz baths are required to keep the parts clean. The warts should then be bathed with 1 per cent. lactic acid, and strips of lint soaked in the same solution should be wrapped firmly round the base of each part of the growth, and the whole covered with oiled silk. These dressings may require to be changed very frequently, as the discharge is very copious. Small warts may be

treated by painting them with pure lactic acid (B.P.). The growths begin to drop off in four or five days, and even the largest masses will disappear in a few weeks, leaving not even a scar. Surgical excision, caustics and cauteries are unnecessary; even when they are used they may leave disfiguring scars, at the edges of which little papilliform growths may appear. The only case in which this lactic acid treatment is likely to fail is where there is a double infection of syphilis and gonorrhœa. In such a case the removal of the growth may be very difficult by non-surgical measures, even after a full course of antisyphilitic treatment.

Proctitis.—The rectal mucous membrane may be the seat of a gonorrhœal infection, usually secondary in character. This complication is more common in women than in men. The indicative symptom may be pruritus ani, or the presence of gonorrhœal warts round the anus. Sometimes the symptoms become acute, with the discharge of blood and pus, fissures and erosions, and pain on defæcation: such cases may become chronic and lead to stricture of the rectum.

Cleanliness is the chief point in treatment. A bismuth ointment should be applied internally and externally. Only in obstinate cases need the rectal wall be treated with silver nitrate solution.

Other Lesions.—The spread of gonorrhœal infections to the uterine cavity causing an endometritis, and to the Fallopian tubes causing salpingitis, are considered with the diseases of these organs.

In pregnancy the vascularity of the reproductive canal allows the gonococcus to penetrate more deeply into the walls of the canal, especially into the vaginal mucous membrane, than usual. This condition has already been considered in Chapter XIII (p. 281).

GONORRHOEAL VULVO-VAGINITIS IN CHILDREN

Vulvo-vaginitis in children is met with not uncommonly. Recent investigation has shown that only in a small proportion of cases is the gonococcus responsible for the condition. Usually the infection results from uncleanness, bad habits, or in the course of some general illness.

Of the gonococcal cases, very few result from criminal assault; the majority arise by contamination of infected articles or clothing. Infection may the more readily occur because the labia majora are undeveloped in the child and the mucous membranes of vulva and vagina are thin and have little resistance to infection (p. 866).

The condition may run a very acute course, but in older children the lack of symptoms, apart from discharge, may be surprising. Redness and œdema of the urethral orifice and hymen are found, and purulent discharge issues from both urethra and vagina. The whole vulva is inflamed and often excoriated and bathed in pus, yellowish or greenish in colour. Very careful investigation, after thorough cleansing of the part, is necessary to determine whether or not the

case is one of gonococcal infection, swabs being taken from the urethra, vagina and perhaps from the rectum. In cases which relapse or are resistant to the usual treatment, it is probable that infection is present in either cervix or rectum, or both.

Treatment.—Every effort must be made to keep the parts clean and dry. If the discharge is profuse, the labia should be kept apart by strips of lint to prevent surface ulceration. Dry swabbing is usually found adequate for local treatment, but should be done by a well-trained nurse each day. Some success was obtained by the production of a temporary premature puberty by the administration of œstrin tablets orally, but recently sulphapyridine has been found to give excellent results and is well tolerated by children: over three years ($\frac{1}{2}$ gram, *q.d.s.*, seven days); under three years ($\frac{1}{4}$ gram, *q.d.s.*, five days); and under one year ($\frac{1}{8}$ gram, *q.d.s.*, five days).

SYPHILITIC INFECTIONS

The manifestations of syphilis in the female reproductive organs are relatively unimportant compared with the influence of that disease on the tissues of the woman's body generally. However, they are so characteristic in their form, at whatever stage of the disease they may occur, that they are described here.

Course of the Disease.—This is divided clinically into three stages—*primary*, *secondary* and *tertiary*, each of which is characterised by special types of lesions. The causal organism is the *Spirochaeta pallida*, which is usually transmitted from one person to another during sexual intercourse, though it may be transferred by kissing, by suckling an infected child, or by using cups, spoons, etc., which have been recently used by a syphilitic person in an infective stage of the disease. The organism occurs very freely in the tissues of a primary sore, and can be identified in the exudate. In a short time it invades the blood-stream and permeates all the tissues of the body, appearing in all its secretions. This universal infection continues from the late primary to the end of the secondary stage. By the time the tertiary stage has been reached the organisms are much more scanty and the spirochaete may be found with difficulty. We refer here only to the local manifestations of the disease.

PRIMARY SORE.—The primary lesion may appear on the vulva, vagina or cervix. It is very often missed, either because its situation prevents its being seen, or more often because it has disappeared before the patient comes for advice. It is usually single, but multiple sores are more common in women than in men, and usually appear on opposing surfaces. The sore, having the form of a granuloma, is raised above the level of the surrounding skin or mucous membrane; central necrosis occurs, causing abrasion, and, in many cases in women, is followed by secondary infection. The actual form of lesion varies:

in women of cleanly habits the most frequent is the "Hunterian chancre," arising as a papule, the surface of which disappears to leave a small, clean, round or oval sore with an indurated base. There is little secretion and the lesion is insensitive. This characteristic induration of the base is not found in all primary lesions in women. A common form is a septic abrasion or fissure with tense oedema of the surrounding tissues, the oedema being due to syphilitic lymphangitis.

At the vulva the descending order of frequency of the situation of the sore is as follows: labia majora, labia minora and the base of the clitoris. On the vaginal wall the usual site is posterior and near the entrance, and the lesion frequently takes the form of a fissure, which causes tenderness on stretching. On the cervix it may suggest an early epithelioma in appearance, but the clinical history, the absence of induration, and the microscopic examination of the tissue enable a diagnosis to be made. As spontaneous healing occurs in the primary sore within two months, these lesions may easily escape notice.

Diagnosis.—The sore usually forms about three weeks after infection. The lesion itself is characteristic, and some ten days after its appearance there is the usual enlargement of the lymphatic glands. There is little pain, and little pus formation. The most important point in diagnosis is the identification of the *Spirochaeta pallida* in serum expressed from the sore. The Wassermann reaction does not become applicable until the sore has been present for two or three weeks. The surface of the sore should be cleansed with saline solution—no antiseptics should be used—and the serum should be expressed from the depth of the sore. If antiseptics have been used, a saline dressing should be applied for twenty-four or forty-eight hours. The best procedure is to examine the exudate at once with dark-ground illumination. When the specimen has to be sent to a laboratory, serum in quantity should be drawn into a capillary tube and sealed at both ends. The spirochaetes have a characteristic appearance, and remain motile for several hours after removal from the body.

SECONDARY LESIONS.—These lesions occur on the external surface of the vulva and the neighbouring skin as moist papules—*condylomata lata*. They form raised, dirty-white or livid growths with flattened surfaces, moistened with serous exudate and disintegrating epithelium.

On the inner surface of the vulva the usual secondary lesion is the mucous patch—a superficial epithelial necrotic area, which becomes abraded to form a shallow ulcer. Several patches may be present at one time. They may occur on the vaginal wall or on the cervix, and perhaps on the endometrium.

TERTIARY SYPHILIS.—In the vulva there may be a partial or complete hypertrophy, which may be associated with a slowly progressive ulceration commencing from the surface. Gummata

may form in either labium majus and produce a crater-like ulcer. Sclerosis of the vulva may be a late manifestation.

Our knowledge regarding the manifestations of tertiary syphilis in the internal reproductive organs is very inexact. These organs are as likely to be the seat of generalised hypertrophy with eventual sclerosis, or of gumma formation, as any of the other internal organs, but subjective symptoms are usually absent and the conditions are probably missed. Ovaries, tubes and uterus may be generally enlarged, due to hypertrophy; locally enlarged, due to gumma formation; or shrunken, due to sclerosis. A disintegrating gumma in the uterus may cause hæmorrhagic discharge. A uterus with gummata may have to be differentiated from a uterus with fibromyomata, because the nodules present may be multiple in both instances.

Diagnosis.—Tertiary syphilitic lesions have to be distinguished from tuberculous lesions, epitheliomata and myomata. The Wassermann reaction should be obtained in all cases. Other evidences of syphilis should always be investigated, and where any reasonable doubt remains, a course of antisyphilitic treatment should be tried.

Treatment of Syphilis.—For details of treatment, textbooks dealing with this subject should be consulted. Early diagnosis is one of the greatest assets in treatment. The administration of arsenical preparations of the salvarsan type by the intravenous route, and of a bismuth compound by intramuscular injection should be commenced without delay, and continued until well after apparent cure is affected and appropriate tests proved negative for two years.

Before marrying, and on becoming pregnant, the patient's blood should be re-examined.

In pregnancy, intravenous treatment is of the greatest importance, the full course being gone through. Syphilis as it affects the pregnant woman is considered in Chapter XIII (p. 280).

CHANCROID (SOFT SORE)

The *soft sore* may be conveniently considered here because of its close association with the other diseases communicated during sexual intercourse. It is due to the implantation of Ducrey's bacillus on the external reproductive organs, and has an incubation period of four to fourteen days. It appears as a small, dirty-looking ulcer with sloughy base and undermined margins, but may grow to a considerable size. The lesion is usually multiple, and there is a more definite inflammatory reaction than with a syphilitic sore. The sores are tender; free pus formation occurs, and the inguinal glands on one or both sides become enlarged, reddened and tender, usually with pus formation.

This sore may be distinguished from a primary syphilitic sore by the incubation period, by its tenderness, purulent discharge and the absence of the spirochæte. The condition of the inguinal glands is

quite different. There may be a double infection of soft sore and syphilis, and to prevent this passing unnoticed, the Wassermann reaction should always be taken three months after exposure to infection.

TREATMENT.—The sores should be cleansed with hydrogen peroxide and eusol. Powdered iodoform is the most satisfactory dressing, but a wet dressing of eusol is quite useful. The inguinal glands should be aspirated with a 10 c.c. syringe as soon as pus has formed, the needle being introduced through sound skin.

A rapid response to chemotherapy with sulphonamides has recently been claimed.

TUBERCULOUS INFECTIONS

When we remember what a large percentage of the population suffers from tuberculous disease in some form or other, it is not surprising to find that the reproductive organs are involved in a considerable number of cases. A tuberculous lesion of the reproductive organs, however, usually advances so insidiously that the identification of an organic pelvic lesion as tuberculous may not be made until operation. Quite often, indeed, the pathologist informs the surgeon that the Fallopian tubes, removed on account of salpingitis, have really been the seat of a tuberculous lesion, and that "giant-cell systems" have been identified in the tissues. It is only where the appearance of pelvic discomfort with physical signs is associated with a known tuberculous pulmonary lesion, and where puerperal and gonorrhœal infection can be excluded, that a clinical diagnosis of tuberculous pelvic disease is usually made. In a few cases the appearance of chronic ascites in a young woman, without any trace of cardiac or renal disease, leads to a diagnosis of tuberculous peritonitis. The frequency of associated pulmonary or other tuberculous lesions lessens the diagnostic value of such reactions as von Pirquet's or Calmette's.

The frequency with which the various portions of the reproductive organs are affected by tuberculous disease stands in the following descending order: tubes, corpus uteri, ovaries, cervix, vagina and vulva. Primary tuberculous infection of the vulva, vagina or cervix uteri is seldom found; in a very few cases infection may occur from discharges from the bladder or bowel, or from the semen of an individual suffering from tuberculous epididymitis—thus giving rise to an ascending lesion.

Descending infections are by far the commoner variety, and the channel of infection may be by direct extension through the Fallopian tube from tuberculous mesenteric glands or a general peritonitis. While the frequency of the main lesion near the abdominal ostium of the tube supports such a view, it is always difficult to exclude the possibility of infection through the blood-stream. The modern

tendency is to regard the blood-stream as the chief source of genital tuberculosis. Tuberculous lesions of the reproductive organs are generally, therefore, secondary to similar lesions in the lungs, mesenteric glands, peritoneum, bladder, etc.

The prognosis in genital tuberculosis is grave, but the gravity depends on the extent and activity of the other tuberculous lesions present. If the primary lesion is quiescent, the reproductive lesion may be eradicated by surgical means, and, by the removal of the handicap of menstruation, the woman may be placed in a more favourable position for a complete recovery. The relationship between tuberculous pulmonary lesions and menstruation has already been referred to in connection with amenorrhœa.

Where the primary lesion, or any other lesion present, is still active, surgical interference in the pelvis should not be undertaken, because improvement after a radical operation is very uncertain.

Vulva.—Tuberculosis of vulva is very rare. It occurs most often in cases showing active tuberculous lesions in the lungs, the general state of the patient being poor. The condition may be either ulcerative or hypertrophic in form. Vulval pain and pruritus are usually present. In the differential diagnosis, esthiomène, soft sore, gumma and epithelioma must be kept in mind. The hypertrophic form may resemble elephantiasis.

Treatment is directed to the patient's general state and the vulval lesion treated with suitable applications.

Operation for removal of the ulcerated or hypertrophic area is seldom warranted.

Vagina.—An ulcerative tuberculous lesion may occur in the vagina, especially after parturition, and then it may be said to originate in a damaged area of the wall. The ulcers are of the usual form, irregular in shape and elongated in the long axis of the vagina. Vaginal tuberculosis is practically always secondary.

Treatment is carried out as in tuberculosis of the vulva. When the patient is fit and the lesion is high in the vagina, it may be dealt with by complete hysterectomy with the removal of a vaginal cuff. At lower levels the ulcer may be widely excised and the edges drawn together.

Uterus.—(a) *Cervix.*—This occurs almost always as an extension of tuberculosis of the Fallopian tubes and body of the uterus. In a few cases it may be an extension from the bladder or vulva. It may form either an ulcerative or a proliferative lesion. Hypertrophy of the cervical glands occurs. In the ulcerative type the ulcers are irregular in outline and are situated near the external os. The proliferative type leads to the formation of multiple papillæ, which may close up the canal and lead to the formation of a pyometra. There may be a purulent foul-smelling discharge from the vagina with hæmorrhage; pain is not a feature.

The disease (Fig. 352) resembles carcinoma in its clinical features, though the induration is not so marked. In the proliferative type the hæmorrhage may be quite as pronounced; in the ulcerative type the discharge may be quite as foul. In some cases the original lesion presents the appearance of a primary syphilitic sore. Diagnosis can only be made by microscopic investigation of the tissue.

Where the cervix only is affected it should be removed by high amputation. Where the cervical lesion is a spread from a higher lesion and the condition of the patient warrants such a procedure, the whole uterus, tubes and ovaries should be removed.

(b) *Body of the Uterus*.—The body usually becomes involved by extension from the tubes; in a relatively small number of cases it may be the seat of the first lesion in the reproductive tract. Whereas the cervix is involved alone in only 2 per cent. of cases, and body and cervix together in 13 per cent., the remainder show lesions in the body only. Apart from the acute miliary type, where the uterine and the other local lesions are of comparatively little importance, the tuberculous lesions in the body are always chronic. In a few cases they may commence in the peritoneal coat; but in the vast majority the site is in the endometrium, and

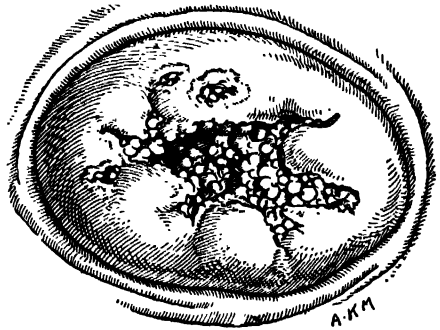


FIG. 352.—Tuberculous Ulceration of Cervix.

is an extension from the Fallopian tubes downwards. The muscular coat may become involved later. The endometrial lesion is so characteristic that the condition is often described as “tuberculous endometritis” (p. 918). Giant-cell systems appear, then caseation and ulceration. The thickening of the endometrium may be so great that the lower portion of the canal becomes occluded, and a pyometra results. In other cases the processes may spread along the lymph spaces through the wall and produce a tuberculous inflammation of the whole organ so that the body of the uterus becomes enlarged.

Occasionally tuberculosis of the body of uterus may be found along with fibromyomata, or even carcinoma. The symptoms do not assist us in arriving at a diagnosis; there is usually menorrhagia and leucorrhœa, but in advanced cases there may be amenorrhœa. The routine examination of curettings may accidentally reveal in an early case the presence of giant cells, while later, caseous debris may be discharged from the uterine cavity. In most cases the tubes also are involved, and the actual condition of the uterine body may not be identified until an operation has been performed for the removal of the diseased tubes and uterus. The advisability of removing the affected

organs depends on the general condition of the patient ; such minor operations as curettage are of only diagnostic value, because the uterus is so seldom the sole organ affected but also because the curette does not remove all the foci, even in the uterus itself (*vide* p. 919).

Fallopian Tubes.—The condition of tuberculous salpingitis is such a characteristic tubal disease that its discussion is postponed until Chapter LI (p. 1032).

Ovaries.—Primary infection of the ovaries is rare, these organs being usually involved in tuberculous disease of the tubes and peritoneum. The germinal epithelium and tunica albuginea are fairly resistant, and invasion usually takes place through a Graafian follicle or corpus luteum, or through the hilum by the blood-stream. The organ becomes enlarged and caseation occurs. In the terminal stage there may be only an ovarian shell surrounding a collection of pus. Both ovaries are usually affected. The treatment depends on the treatment of the associated salpingitis.

Peritoneum.—While tuberculous disease often spreads to the reproductive organs from the peritoneum, the two conditions have usually to be considered together by the gynæcologist. Very frequently this peritoneal condition is found associated with chronic salpingo-oöphoritis, with all the internal organs of reproduction matted and adherent. In several of these cases there may have been an infective lesion of the tubes and ovaries of puerperal or gonorrhœal origin, and the subsequent tuberculous lesion has therefore been able to establish itself more easily. A greater or less amount of free fluid is present, and in certain cases pockets of caseous material or pus may be found.

This condition has to be differentiated from an acute miliary tuberculosis, which is fairly common in young women, and which may be associated with ascites. Little importance attaches in such cases to the local lesions ; the patient's general condition is too serious.

The tendency to the formation of adhesions in these cases accounts for the great variety in the symptoms, and also for the sudden complications which may occur in chronic tuberculous peritonitis. In many cases there may be no symptoms except gradual abdominal distension, due to tympanitis as much as to ascites ; in others there may be a history of abdominal discomfort and pain, sickness, vomiting and sometimes febrile disturbance ; in others there may be an attack resembling in its symptoms an ovarian cyst with a twisted pedicle, a perforated duodenal ulcer, or an intestinal obstruction. In such cases a coil of intestine has generally become caught in the adhesions or bands. Where the symptoms are less acute, there may be pressure low in the pelvis with dysuria. Emaciation occurs apart from vomiting, and the veins of the abdominal wall appear dilated. The febrile disturbance has led in many cases to a diagnosis of enteric fever until the Widal test has corrected it ; this mistake has occurred also in the acute miliary type.

The physical signs are most variable. There may be irregular thickenings resembling a solid tumour, or collections of fluid resembling a multilocular ovarian cyst. When the parietal peritoneum is thickened, the doughy feel of the abdominal wall is characteristic. Many cases require examination under an anæsthetic before a diagnosis can be arrived at.

Prognosis and Treatment.—Except in young children, where the proportion of miliary tuberculosis is high, the prognosis is surprisingly good. The general condition of the patient and the state of the lungs in particular are of great importance ; loss of appetite, fever, diarrhoea, and emaciation are unfavourable symptoms.

In cases which have been identified early, it is advisable to send the patient for several months for sanatorium treatment. If no sign of improvement occurs, or if the case is first seen at a later stage, an abdominal operation should be advised. Great care must be exercised in entering the abdominal cavity, because the bowel is very likely to be adherent to the parietal peritoneum. Complete recovery may follow the mere evacuation of the ascitic fluid, especially in cases where there are few adhesions. If the ovaries and tubes are extensively involved, it is better to remove them, but the greatest care must be exercised in separating adhesions, because the bowel wall is very easily damaged and very difficult to repair.

Good results have been reported following the treatment of tuberculous peritonitis by X-rays.

PARASITIC DISEASES

In this country, fortunately, we have a very small number of the graver types of parasitic disease, such as those caused by the echinococcus and the streptothrix ; but infection from the protozoan, *Trichomonas vaginalis*, is not uncommon as it is able to flourish in the acid medium of the vaginal canal—reference is made to it in a previous chapter (p. 796). More rarely, infection by *Bilharzia hematobia* may occur, as the eggs shed by this round worm may be deposited beneath the mucous membrane and cause so much irritation that warty growths like condylomata may be formed. Similar lesions may occur in the cervix.

In children and in a few adults the threadworm (*Oxyuris vermicularis*) and the round worm (*Ascaris lumbricoides*) may find their way into the vagina, but extremely seldom are they able to make their way through the uterus to the tubes. Threadworms may be associated with vulvo-vaginitis in children.

Hydatid Disease of the Pelvic Organs.—Hydatid cysts may appear in the pelvis either by primary growth in that region or following the rupture of a primary cyst in the liver. In either case the cyst usually develops first of all in the pelvic connective tissue,

and spreads from there to the surface of the tubes, ovaries or uterus. The disease, as it affects the pelvis, presents no special features, except that it may give rise to pressure symptoms. The history of a previous operation on a hydatid cyst of the liver would give a clue to the condition. Precipitin and complement-fixation reactions have been devised to aid diagnosis. In many cases diagnosis is only made at an abdominal operation.

Treatment should consist in complete removal of the cysts where that is possible. Where they are buried in the cellular tissue, and their complete removal is impossible, the cysts should be emptied without allowing the general abdominal cavity to be contaminated, and the endocyst and ectocyst should be completely removed with a view to preventing recurrences.

Streptothrix Infections.—The term streptothrix includes higher bacterial forms which are pathogenic to man, and of which the best known is the ray fungus, *actinomyces*. The lesions resemble those produced by tuberculosis, leprosy and syphilis.

In man most of the lesions are in the jaw and pharynx. Pelvic lesions are usually secondary to an invasion from the intestine, especially through the appendix. Entrance *per vaginam* is very rare. The microbe tends to grow along natural ducts, and therefore the Fallopian tubes, the ovaries, the uterus, even the external genitalia may become involved.

Streptothrix colonies have been identified on swabs taken from a uterine cavity which was the seat of a persistent purulent discharge. Good results have been recorded from the use of autogenous vaccines.

INFECTIONS FROM THE BOWEL, APPENDIX AND DIVERTICULA

These lesions, in so far as they simulate affections of the reproductive organs, are referred to in connection with Pelvic Peritonitis considered in Chapter LII.

CHAPTER XLVI

DISEASES AND INJURIES OF THE VULVA AND VAGINA

I. THE VULVA

INFLAMMATORY LESIONS OF NON-GONORRHOEAL ORIGIN

Vulvitis.—In some cases in children, and in many cases in adults, the infective agent is the gonococcus, and this type of vulvitis has been considered in the preceding chapter.

Adults.—In adults simple vulvitis may occur in women of unclean habits through the implantation of pyogenic organisms or from accidental infections. More chronic inflammatory lesions of the vulva occur in association with persistent muco-purulent vaginal discharges of either cervical or corporeal origin: such women very often suffer also from pruritus vulvæ. To this category belong a certain number of cases in which the lesion is a senile endometritis or senile vaginitis (p. 917). Then, again, diabetic subjects may suffer from vulvitis with pruritus and local ulcerations.

The vulva is red, swollen, and tender to touch, with a copious purulent secretion covering the surface. The discharge should always be examined bacteriologically, so that cases of gonorrhœa may not be missed and infection by *trichomonas vaginalis* and *monilia albicans* (p. 881) may be identified. In adults there is seldom much constitutional disturbance, but in children there may be pyrexia, irritability, restlessness and some inguinal adenitis.

Strict cleanliness is the first essential in treatment. In the acute stages sitz baths help to relieve the local discomfort: in the intervals, lint soaked in boracic or lead lotion should be applied between the labia and over the vulva. If the infection has spread to the vagina the condition should be treated as indicated under Leucorrhœa (p. 797).

Glycosuria should always be excluded before local treatment is initiated if there is no evidence of severe infection.

Children.—In children of poor physique, or in those who have been badly cared for, there may be extensive vulvo-vaginitis, the organisms being generally the *B. coli* or staphylococci. Such cases frequently occur in association with the presence of *Oxyuris vermicularis* or *Ascaris lumbricoides*, the scratch wounds resulting from the irritation of these parasites becoming infected. In the acute specific fevers,

especially where nursing has been careless, acute vulvitis may occur, with great destruction of tissue.

Rest in bed is essential: at first fomentations should be applied to the vulva, replaced later by three-hourly sponging with boracic acid solution. Strips of lint should be placed between the labia.

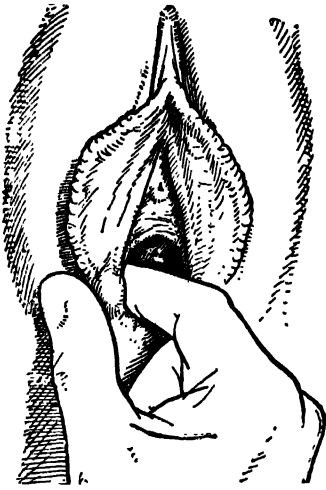


FIG. 353.—Palpating a small chronically infected Bartholin's Gland.

Strong antiseptic solutions should not be used. Lactic acid (1 dram to a pint) may be employed with advantage. Vaginal douching should not be employed in children unless an acute vaginitis has become established. If vaginal douching is necessary lactic acid solution is preferable to weak antiseptics (*vide* Vulvo-vaginitis of Gonorrhœal Origin, p. 873).

Bartholinitis.—Bartholinitis is very frequently found associated with gonorrhœa. There are many cases of Bartholinitis, however, which are not of gonococcal origin. The inflammation may be very *acute*, leading to rapid abscess formation: in this type the pain is extreme.

In other cases the course may be more *chronic*—the gland becomes enlarged and its duct thickened, and there are recurrent attacks of pain and swelling, with occasional purulent discharge. This is a most obstinate and irritating condition. On inspection in the quiescent phase there may be no sign of disease, but palpation of the posterior edge of the vulva between the finger and thumb will reveal the enlarged gland (Fig. 353). Occlusion of the duct in mild chronic infection leads to the formation of a Bartholin's cyst (p. 891).

Treatment.—In the acute form the gland should be aspirated (p. 870). Occasionally the abscess ruptures spontaneously on the inner side of the labium minus. Incision gives only temporary relief, because the wound closes and the gland will almost certainly swell up again. In all such cases, when the acute stage subsides, and in all chronic cases, the gland *should be completely excised*. Any treatment short of this is unsatisfactory, because the organisms are left in the remains of gland tissue, and may become active again at any time.

Special Types of Vulvitis.—There are several special types of vulvitis, the incidence of each of which is comparatively rare, but the characteristics of which are so marked as to require special descriptions.

Erysipelatous Vulvitis.—In the days before the use of antiseptic and aseptic methods, this was a not infrequent complication of the

puerperium, due to the infection of wounds of the vulva by the *Streptococcus pyogenes*. It is now a rare condition. It is a very virulent infection, in many cases fatal, characterised by all the usual local and general symptoms of acute infection. A spreading cellulitis with abscess formation may occur, when incisions should be made and antiseptic fomentations used. Most careful nursing is required: an adequate diet must be maintained, stimulants given, and iron administered in the form of the perchloride. Sulphanilamide should be administered (p. 652).

Gangrenous Vulvitis.—This very rare condition occurs as a complication of the puerperium or of venereal disease of the vulva. Occasionally it is a complication of acute infectious diseases in children, particularly measles. In the last type it may occur, under the designation of "*Noma*," as a localised but very dangerous lesion in debilitated patients. The patient complains of pain and shows the usual indications of septic absorption. The local lesion is in most cases unilateral: the labium becomes swollen and black, and extensive sloughing and ulceration quickly follow. *Noma* begins as a black spot surrounded by induration, the whole of the area soon showing progressive gangrene. The infected area should be excised under an anæsthetic. Afterwards the area should be bathed with hot antiseptic solution, and if necessary antiseptic fomentations should be applied. The general condition requires most careful supervision—a suitable diet and tonic should be prescribed.

Membranous Vulvitis.—This form occurs more commonly as a result of superficial necrosis of the labia in a streptococcal infection than to the actual implantation of the Klebs-Löffler bacillus on the vulva.

The membrane in the true diphtheritic form is whiter in colour than that occurring in the necrotic type. Before treatment is undertaken, a bacteriological examination should be made to ascertain whether the diphtheritic bacillus can be found. True diphtheritic conditions should be treated with antidiphtheritic serum. In the other types careful cleansing of the area should be carried out with antiseptic solutions of biniodide of mercury (1 in 500) or Dettol (p. 401). If the inflammation has extended into the vagina, that canal (but not the uterine cavity) should be douched two or three times daily. The patient should be propped up to favour free drainage.

Aphthous Vulvitis.—This form is due to the growth of the mycelium of the *Oidium albicans* and is characterised by the appearance of white spots on the inner surface of the labia, with redness and œdema. The removal of the white spots reveals little ulcers on the mucous membrane. The disease occurs in debilitated patients, old or young, and it may develop during pregnancy (p. 283), especially if glycosuria is present.

The patient should be kept in bed and the vulva painted daily with

1 per cent. aqueous solution of gentian violet. A diet rich in vitamin A and D should be prescribed and the urine watched for sugar, which may occur intermittently.

Furunculosis.—The boils occur in the hair follicles on the outer surface of the labia majora : in most cases the general health is poor. Rest in bed, tonics and absolute cleanliness are required. The development of the boils may sometimes be arrested by the application of tincture of iodine : in most cases, however, the boils continue to develop until they burst spontaneously or are incised. Vaccines are sometimes helpful. Vitamin A should be administered (Radiostoleum or Adexolin).

Herpetic Vulvitis.—This is a rare condition but it may affect both pregnant and non-pregnant women. In pregnant women herpes of the vulva may be most troublesome. Great pain precedes the eruption and intense pruritus occurs as soon as the vesicles appear. These are arranged in groups and become pustular before they rupture and dry up. While the crops of vesicles tend to run their own course, recovery may be hastened by complete rest, dieting, and the application of lead and opium lotion. Some cases do better if the parts are kept dry, and dusted with zinc and starch powder. Restlessness and insomnia may require bromides and chloral.

Eczematous Vulvitis.—This condition usually occurs after the menopause. In chronic cases the skin becomes dry and scaly, and the patient complains of constant burning pain and itching. Oestrin therapy is often helpful by improving the nutrition of the part.

Intertrigo Vulvæ.—This condition is common in cases where there is a chronic cystitis or a chronic leucorrhœa, and in stout women. The discomfort should be relieved by frequent bathing, and treatment of the associated cystitis or leucorrhœa should be undertaken.

Lymphogranuloma Inguinale (Esthiomène).—This is a spreading ulceration of the vulva with both cicatrisation and hypertrophy of the tissues, resulting in great distortion of the parts. The appearance of the lesion caused it to be described at one time as "*lupus vulvæ*," but no histological confirmation of an origin of this nature has been obtained. It occurs most commonly in prostitutes. It is now classed as a parasymphilitic lesion. In many cases the Wassermann reaction is negative, but a history of an actual, or at least probable, attack of syphilis can often be obtained. However, there is now reason to believe that the condition may be due, not to syphilis, but to a filterable virus.

The disease is a slowly progressive one, proceeding from inflammatory patches on the mucous membrane to large serpiginous ulcers burrowing around the urethra, the base of the bladder and the rectum, the actual ulcers being separated by masses of hypertrophied tissue. The combined processes of ulceration, hypertrophy and cicatrisation produce great disfigurement of the parts. There is very little constitutional disturbance in this disease, and until the late stages,

when fistulæ cause great discomfort, the local subjective symptoms are practically negligible. Enlargement of the inguinal glands is common.

Antiseptic applications should be employed and specific therapy tried. If improvement does not occur, the diseased area should be freely excised before the ulceration becomes extensive.

Elephantiasis Vulvæ.—The condition is rarely found in this country: it is due to obstruction of the lymphatics of the vulva by the *Filaria sanguinis hominis* and is encountered, therefore, in tropical countries where that parasite is found. Great enlargement of the labia majora, sometimes of the labia minora, takes place, with the development of multiple papillary processes. The normal skin remains covering the tumour, except where there is pressure ulceration. The skin, however, is very thin and the epidermal papillæ are absent: underneath is found loose connective tissue with huge lymph spaces. The secretion of the skin collects in the interstices, decomposes and becomes very offensive. The growth may assume very large dimensions, and by its bulk and the offensive secretion cause the patient much discomfort. The growth should be excised.

Leucoplakia Vulvæ.—This is a chronic inflammatory disease of the vulva which develops usually at or after the menopause. Its origin is unknown. It may affect the skin in one or two localised areas, or the whole vulvar region may be involved except the urethral orifice and vestibule. The labia majora are most commonly affected, but the labia minora, the perineum, and the anal region may also be attacked by the disease. The condition begins with hyperæmia of the skin; this is followed by marked thickening of the epithelial tissue and keratinisation of the surface layers. The epithelial papillæ hypertrophy and dip down deeply into the subjacent connective tissue, which becomes infiltrated with inflammatory cells. The elastic tissue beneath the skin gradually disappears and the whole area loses its resiliency. Later cracks and fissures make their appearance over the dry skin area, and at this stage there is real danger of *epithelioma* developing. Later still, retraction of the vulval tissues may occur and the epithelial layer becomes thinned out. The appearance may then be one of a smooth, white, shiny surface with atrophy of the labia and clitoris.

The outstanding symptom is intolerable pruritus: scratching can hardly be avoided, and this, combined with cracks and fissures, causes pain and soreness to be added to the itching. The seriousness of leucoplakia lies in the fact that it predisposes to the development of epithelioma. According to Taussig, about 50 per cent. of cases of vulval epithelioma are preceded by leucoplakia.

Treatment.—In the earlier stages strict cleanliness and the application of lotions or pastes should be tried, as described for functional pruritus vulvæ (p. 889). Œstrin therapy is frequently of the greatest

value, and vitamins A and D should be taken. Scratching must be avoided, and to this end alkaline baths and sedatives at night should be ordered. If the condition progresses, excision of the vulva will have to be considered—this at once brings relief and removes the risk of malignancy.

Kraurosis Vulvæ.—This disease differs from leucoplakia in that the changes are from the first of an *atrophic type*. The condition usually occurs after the menopause, but cases have been described as occurring in younger women after the surgical removal of the ovaries. The labia minora, the vestibule, and the urethral and vaginal orifices are involved: the rest of the vulva escapes, and the thighs are not involved. The diseased area is at first red and glistening, with small purple areas over its surface, especially in the region of the hymen or its remains. The urethral orifice may show the formation of a caruncle. Later, the surface becomes pale, shiny and perfectly smooth. The labia minora and the clitoris disappear: the pubic hair is shed: the vaginal orifice becomes contracted. In this type of case the epithelium is thinned: the epidermal papillæ atrophy and disappear: plasma cells are prominent in the underlying tissue, especially in the purple areas: mixing with the plasma cells and surrounding them are found a large number of polymorphs, while numerous lymphocytes appear still deeper in the tissue.

In the early stages of the disease, the affected area is very sensitive. Later, constant pain and pain on micturition develop. Dyspareunia occurs owing to the vaginal stenosis, and remains after the other symptoms have disappeared. *This condition must always be differentiated from leucoplakia vulvæ—the area of distribution, the pathology and the prognosis are different. Kraurosis is not associated with epithelioma of the vulva.*

All the symptoms tend to disappear except the dyspareunia. In the early stages the various soothing applications advised for pruritus should be used. At that time a certain amount of relief may be secured by cauterisation of the tender areas. Some cases are benefited by œstrin therapy.

The origin of this condition is unknown. Apart from the presence of the polymorphonuclear leucocytes in the tissues, there is no sign of an inflammatory lesion: all the tissue changes are atrophic.

Pruritus Vulvæ.—Pruritus is only a symptom, but a distressing one, and a careful search for the cause should be made in every instance. The urine should always be examined for sugar, repeatedly if necessary, even if an obvious lesion be discovered. Glycosuria may accompany local abnormalities or may occur without them. It must be remembered, too, that the condition of the vulva at the time of inspection may be the result of scratching and not due to a primary lesion.

(a) *Pruritus with Recognisable Cause.*—The following should be considered as causative agents: (i) Glycosuria; (ii) leucoplakia;

(iii) dermatitis, *e.g.*, chronic streptococcal or staphylococcal infection ; (iv) leucorrhœal discharge, especially when due to the yeast fungus or trichomonas vaginalis ; (v) incontinence of urine ; (vi) scabies and pediculi ; (vii) anal parasites ; (viii) adhesion of prepuce of clitoris with smegma collection ; (ix) minute abrasions with trivial infection, often at vaginal introitus. In these cases the appropriate treatment is indicated.

(b) *Pruritus without Recognisable Cause—Functional Pruritus.*—There are, however, a large number of cases in which no primary local cause is discoverable. The patients are usually approaching, or have just passed, the menopause. The condition tends to occur in the neurotic type of woman, and by some authorities the disease is described as a neurosis. Probably the real cause, in a large percentage of cases, is a disturbance of endocrine activity expressing itself by changes in the nutrition of the epidermal structures in the region of the vulva.

The degree of discomfort in pruritus is usually progressive. Beginning as a slight itching at one spot, the disturbance spreads over the whole of the vulva. It tends to be worse at night, and when the patient gets heated. She may become almost a recluse, because the perpetual desire to scratch prevents her mixing with other people : the depression associated with this condition may lead to actual mental derangement.

To effect a cure may be extremely difficult. The necessity for identifying any local or general lesion cannot be too much emphasised. Instructions regarding diet, regulation of bowels, maintenance of adequate urinary excretion and exercise should be given. With regard to diet, simplicity should be aimed at : some cases seem to improve on a vegetarian diet. General tonics should be administered. Pruritus with early leucoplakia or without obvious cause may respond to vitamin A therapy or a multi-vitamin preparation. Swift has pointed out that *achlorhydria* exists in many cases—if this is discovered, hydrochloric acid by mouth should be administered. Owing to the close relationship which exists between the functions of the ovary and the development and nutrition of the external reproductive organs, the administration of œstrone is more beneficial. X-rays may be tried, but the results are generally disappointing.

In the well-marked cases the patient should be kept in bed. In addition to ordinary hot baths, the vulva should be bathed with a solution of bicarbonate of soda, or starch poultices should be applied. In the intervals, lotions, ointments or dusting powders should be applied to allay the irritation. The number of applications recommended is legion, and many may have to be tried before one is found to suit the individual patient. Lotions of 1 in 1000 biniodide of mercury, 1 in 30 carbolic acid, or 1 in 4 to 8 liquor carbonis detergens may be used ; ointments containing resinol with 8 per cent. thymol, or camphor,

menthol, carbolic acid (10 gr. of each) to 1 ounce of lanoline are recommended; the most useful dusting powder is one containing equal parts of oxide of zinc, starch and dermatol.

Sometimes relief follows the use of such caustic solutions as 4 per cent. silver nitrate, 8 per cent. protargol, or 1 in 3 liquor carbonis detergens. Such strong solutions must be applied very carefully. In very obstinate cases, in which treatment on general lines and local applications fail to give relief, the excision of the affected area may be considered; but in extensive lesions this is a very serious procedure and is not always successful in relieving the discomfort.

Syphilitic Lesions of the Vulva and Soft Sore.—Those have been described in the preceding chapter.

Hypertrophy of the External Reproductive Organs.—The labia majora may be enlarged and pendulous in fat people or in cases of old-standing chronic inflammation. The clitoris may be found enlarged as a congenital deformity, of which an extreme type occurs in pseudo-hermaphroditism (p. 106). An enlarged clitoris and labia minora may be associated with the practice of masturbation, in most cases the result, but in some, perhaps, the starting-point of the habit. Chronic inflammatory processes too may cause hypertrophy of the labia minora.

Acquired Deformities of the Vulva.—The tissues of the vulva atrophy after either the normal menopause or a menopause induced by X-rays, or removal of the ovaries. The atrophy in *kraurosis vulvæ* has been referred to.

Adhesions of the labia may occur as the result of vulvo-vaginitis, especially in children; this may necessitate separation by surgical means.

TUMOURS OF THE VULVA

Varices of the Vulva.—The veins of the vulva have not very much support from the surrounding tissues, and consequently become very prominent if there is a tendency to varicosity. This occurs very frequently in pregnancy (p. 246). When the enlargement of pregnancy persists after the puerperium, a bunch of the veins may have to be removed. Injections of the veins with sodium morrhuate is most valuable.

Hæmatoma of the Vulva.—Either as a result of direct violence, or owing to injury during parturition a large hæmatoma may form on the vulva (*vide* p. 606).

Bartholin's Cyst.—This is a fairly common lesion—it often occurs as a sequel to a Bartholinitis where the duct of the gland has become completely or partly occluded. In some cases the cyst involves the duct only. It occupies the same situation (in the postero-lateral part of the vulva) as an abscess, but there is neither redness of the skin nor tenderness on pressure associated with an abscess. The form

is usually pear-shaped, the apex being directed upwards (Fig. 354). The contents are usually serous or mucoid fluid, but they may be dark brown in colour. There may be no subjective symptoms, unless infection occurs. Dyspareunia may be complained of. The conditions resembling this cyst are hydrocele of the canal of Nuck, and femoral hernia. The cyst should be completely dissected out, the dissection to include the whole of the gland and duct.

Hydrocele of the Canal of Nuck.—This condition is of congenital origin, and is due to the occurrence of fluid between the round ligament and its sheath of peritoneum. The relationship between the round ligament in the female and the gubernaculum testis in the male has been referred to in the section on embryology (p. 91). The fluid may or may not be shut off from the peritoneal cavity: in the former case it is said to be encysted. The condition is very rare, and is seldom associated with symptoms.

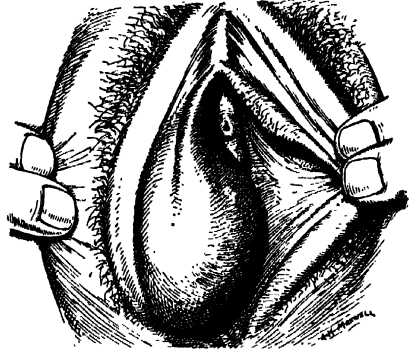


FIG. 354.—Bartholinian Cyst, right side.

The cyst occurs as an elongated translucent swelling in the upper area of the vulva. If it is encysted, it cannot be reduced: a strand of tissue may be felt passing from its upper pole to the external inguinal ring. If the hydrocele is not encysted, it disappears when the patient lies down: in the erect posture it can be traced up to the external inguinal ring. Should the encysted form become infected it may simulate a strangulated hernia, but there will be no intestinal symptoms.

The treatment is complete excision of the sac. When there is a connection with the peritoneal cavity the neck of the sac should be ligated.

Femoral Hernia.—A femoral hernia may present itself as a swelling in the labium majus, having tunnelled its way down from the saphenous opening. The differential diagnosis and treatment of this condition will be found in textbooks on General Surgery.

Other Cysts of the Vulva.—Small retention cysts may occur in the vulva. These may take the form of sebaceous cysts of the labium majus or mons veneris, or thin-walled cysts of the labium minus.

Fibromyoma of the Vulva.—This type of solid tumour arises from the tissues of the labium majus, and soon becomes pedunculated. It is a relatively rare condition and is seldom associated with symptoms. The tumours are usually small, hard and painless, but

they may undergo mucoid degeneration and become soft. The pedicle should be divided and the vessels ligated.

Adenomyoma of the Vulva.—This tumour cannot be distinguished clinically from the fibromyoma. It is a type of neoplasm often associated with embryonic remains, but in this region it may arise from Bartholin's gland. The treatment is the same as for a fibromyoma.

Lipoma of the Vulva.—This tumour (Fig. 355) arises as a rule from the labium majus, and may be sessile or pedunculated. Though usually of small size, it may become so large as to cause dyspareunia and, in very rare cases, dystocia. The tumour is softer than a fibro- or adeno-myoma, though degeneration of the latter may cause confusion. The lipoma is distinguished by the fixation of the skin over the tumour. The treatment is excision.

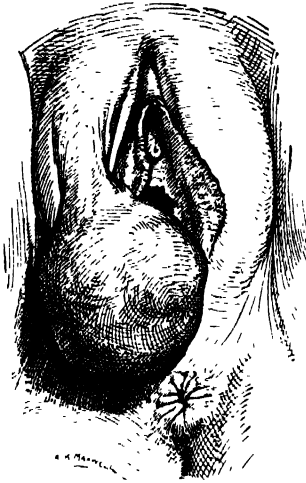


FIG. 355.—Lipoma of Vulva.

Solid Tumours of the Round Ligament in the Canal of Nuck.—Fibro- and adeno-myomata of the portion of the round ligament in the inguinal canal are very rare indeed. They are solid and irreducible and generally cause no symptoms.

Papilloma of the Vulva.—In most cases multiple warts of the vulva occur in association with gonorrhœal infections described in the preceding chapter. Single warts may occur as in other parts of the body, are usually pigmented, and may be the starting-point of a melanotic sarcoma. If these single warts cause irritation, they should be excised or treated with X-ray. When the vulva is covered with warts the best treatment is to shave them off with a razor.

Carcinoma of Vulva.—This condition is a fairly common one, and is to be regarded as a very serious form of malignancy. It develops usually some years after the menopause, the commonest age period being round about sixty years. Occurrence prior to the menopause has, however, been noted. In the great majority of cases the lesion is an epithelioma, but in rare instances an adeno-carcinoma arises in the columnar epithelium of Bartholin's gland or duct.

EPITHELIOMA arises in three situations: (a) on the labia; (b) at the clitoris; (c) at the urethral meatus. The connective tissue of the vulva is of loose structure and so allows of rapid growth of the tumour, though in old women tissue atrophy tends to retard growth. But much more important is the fact that lymphatic drainage from the vulval region is very free, so that spread to deeper structures occurs only too readily. The superficial inguinal glands are soon involved,

but so, too, are the deep pelvic glands by means of the lymphatics which pass through the triangular ligament or under the inguinal ligament. In this way the deep inguinal, iliac, hypogastric and lumbar glands may become involved at an early stage of the disease. Ulceration and infection of vulval growths readily occur, and as a result soreness and pain are often early symptoms. The abundance of secretion in this region increases the tendency to foul-smelling discharge, which adds to the patient's discomfort.

(a) *Epithelioma of the Labia*.—The point of origin is usually on the

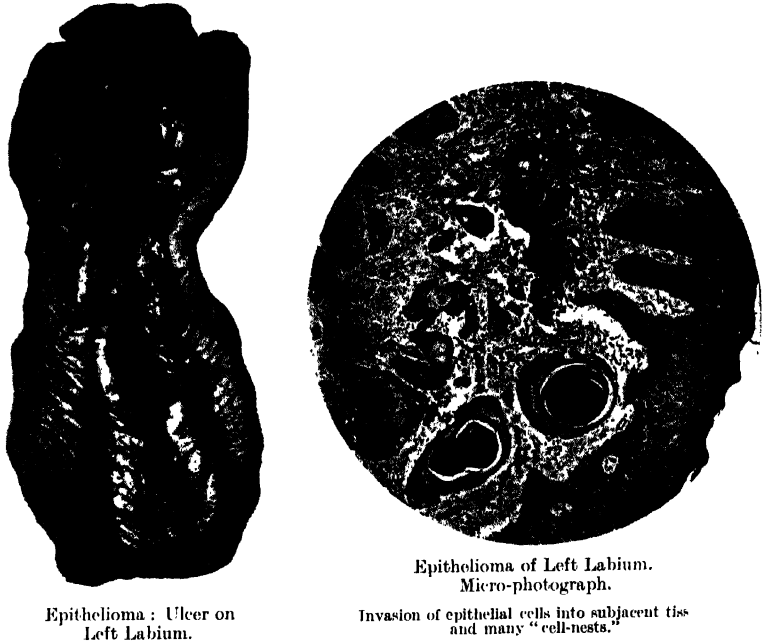


FIG. 356. — Epithelioma of Vulva.

inner surface of the labium majus, though it may be on the labium minus. It has already been pointed out that *leucoplakia* is an important predisposing condition; indeed, the great majority of cases of labial epithelioma follow on *leucoplakia*.

The growth starts as a small hard nodule on the surface of the labium which soon develops a small area of necrosis and ulceration. The patient sometimes states that she has had a discharging "boil" for a long time which has refused to heal. Induration of the tissues surrounding the small nodule occurs, and progressive ulceration and induration ensue until the whole labium and, perhaps, the perineal region or the mons veneris may be involved. Contact ulcers (malignant) on the opposite labium may develop.

Diagnosis is usually easy; but doubt may arise when dealing with

the fissured stage of leucoplakia as to whether the condition has passed from the benign to the malignant state. In such cases a small piece of tissue must be taken for microscopic examination. Occasionally, too, doubt may arise in early stages as to whether the condition is syphilitic.

Treatment.—Complete excision of the whole vulva must be carried out with removal of the inguinal glands on both sides, and then X-ray therapy should be employed to irradiate the pelvis and to destroy malignant cells in the deep pelvic glands. The alternative is to perform Bassett's operation—a procedure which removes the hypogastric and iliac glands in the pelvis at the same time as the vulvectomy is performed. In spite of this radical treatment the risk of recurrence is very considerable.

(b) *Epithelioma of the Clitoris.*—The prepuce of the clitoris is usually the starting-point, and the disease spreads both laterally and deep into the pelvic lymphatics. Early ulceration is the rule, and, when marked, doubt may arise as to whether the disease commenced on the clitoris, on the upper part of the labium, or on the mucous membrane of the vestibule just below the clitoris. Treatment is as for labial epithelioma.

(c) *Epithelioma at Urethral Meatus.*—The disease spreads by induration along the urethra and by ulceration at the meatus. Dysuria is a marked symptom in addition to vulval pain. The application of radium combined with X-ray therapy is indicated, but the prognosis is not good (*vide* epithelioma of urethra, p. 896).

ADENO-CARCINOMA OF BARTHOLIN'S GLAND.—This is a rare condition arising in elderly women. Growth is rapid and ulceration of the labium may be extensive. Lymphatic spread occurs early.

It should be pointed out that a benign tumour of the labial sweat glands—*hyradenoma*—may simulate closely a Bartholin gland carcinoma. Even the microscopical appearance of the benign growth may simulate malignancy.

RODENT ULCER OF THE VULVA.—This very rare lesion occurs as a slowly growing ulcer of the vulva with raised edges. The glands may not become involved, though the deeper tissues may be extensively destroyed. The ulcer should be excised, or radium should be applied.

Sarcoma of the Vulva.—This type of malignant lesion is very much more rare than carcinoma. The primary lesion occurs in the labium majus: ulceration, bleeding and pain occur early. The appearance resembles carcinoma so closely that microscopic examination is necessary to establish a diagnosis. The sarcomatous lesion is usually of the mixed-celled type.

A pigmented malignant tumour of the vulva, described as a *melanoma*, may arise from the labium majus: it is usually a sarcoma, though in some cases the microscopic structure has been found to resemble more a carcinoma. This type occurs in elderly women: it is dark in colour and seldom attains great size. The inguinal glands are early involved and ulceration soon occurs.

If surgical measures are employed a wide excision should be carried out, and the inguinal glands should be removed. The prognosis even then is bad; recurrence is very frequent. Treatment by radium is to be preferred.

Lesions associated with the Urethra.—The most common diseases of the urethra which come under the notice of gynaecologists are: (a) urethral caruncle; (b) prolapse of urethral mucous membrane; (c) carcinoma of the urethra. Urethritis of gonorrhœal origin has been already described (p. 870).

(a) **URETHRAL CARUNCLE.**—This very painful condition occurs as a bright red excrescence at the urethral orifice, either diffusely distributed or as a circumscribed polypus (Fig. 357). The growth arises from the urethral mucous membrane, and the site of origin is usually the

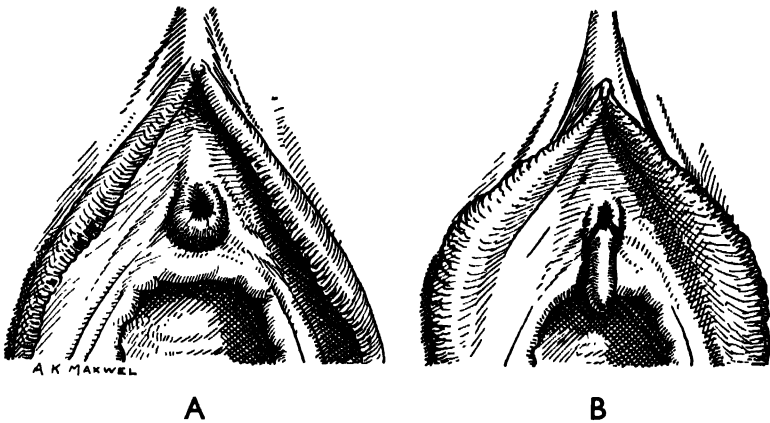


FIG. 357.—Urethral Caruncle.

A. Diffuse.

B. Pedunculated.

posterior wall. The pedunculated form is usually single and about the size of a pea, though it may be much larger. This form is generally tender to touch and may be the cause of dyspareunia. In practically all cases there is pain on micturition and there may be a little hæmorrhage. Caruncles are found most typically in women beyond the menopause, and more commonly in those who have borne children.

As a rule caruncles are granulomata, composed of granulation tissue and covered with stratified squamous epithelium; they result from chronic infection of the terminal portion of the urethra. In a few cases they are adenomata, with sometimes such a profusion of blood-vessels as to deserve the description "angiomata." No nerve elements have been found in these tumours.

Treatment.—Complete excision of the pedunculated growth or of the affected area should be carried out. It is advisable also to cauterise the base with the electric cautery, because the caruncle is liable to recur, especially the diffuse variety. It may be necessary to remove a complete ring of mucous membrane. Recurring caruncles

should always be examined for malignancy, though such a development is rare.

(b) **PROLAPSE OF THE URETHRAL MUCOUS MEMBRANE.**—This condition must be distinguished from urethral caruncle, especially of the diffuse variety. It may occur as an acute condition following some straining effort—*e.g.* defæcation. The prolapsed mass may then be purple or black in colour, owing to strangulation. The urethral canal can be identified in the centre of the swelling. The patient complains of pain, frequency of micturition and vesical tenesmus.

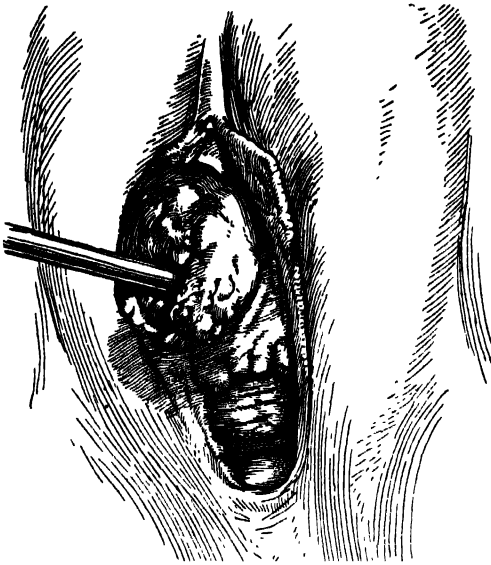


FIG. 358.—Carcinoma of Urethra (catheter in urethra).

More commonly the condition is chronic, and the mucous membrane of the lower portion of the urethra protrudes through the orifice as a red fringe. It usually develops as a result of injury to the neck of the bladder during parturition; but it may occur in ill-nourished children. The symptoms here also are pain and frequency of micturition, but less severe than in the acute type.

Treatment.—In the acute form the patient may have to be anæsthetised before the prolapse can be reduced.

In the chronic form the prolapsed mucous membrane should be excised and the edges of skin and mucous membrane sutured.

(c) **CARCINOMA OF THE URETHRA.**—Primary carcinoma of the urethra is rare, though carcinoma of the uterus, vagina, bladder or vulva may extend to the urethra. In the latter case the extension of the lesion is easily identified.

Primary carcinoma occurs in women over fifty years of age. It arises more commonly at the junction of the urethra and vestibule than from the urethra itself; very rarely it develops from a caruncle. In most cases the tumour has the form of a squamous-celled epithelioma; in the rarer cases which arise within the urethral canal, it is of the adeno-carcinoma variety, the point of origin of which has been the peri-urethral glands. Odd cases of sarcoma and perithelioma have been described.

The tumour at the urethral orifice can be easily recognised in its advanced form, when it usually appears as an ulcerated fungating mass (Fig. 358). In its earlier stages microscopic examination may

be necessary to differentiate it from a caruncle. The intra-urethral type may only be identified by urethroscopic examination, until the tumour is large enough to be palpated through the anterior vaginal wall.

Carcinoma of the urethra is associated with painful and difficult micturition and, when ulceration occurs, constant pain, offensive discharge and bleeding. Occasionally there is retention of urine. The inguinal glands are early affected.

Treatment.—Surgical treatment may be successful in early cases, but even then a wide excision must be made, with removal of the inguinal glands. Radium offers the best chance of cure.

II. VAGINA

INFECTIONS OF THE VAGINA

Vaginitis.—The special characteristics of the vaginal canal which govern its liability to infection have been discussed in the preceding chapter (p. 866).

ACUTE VAGINITIS.—This may occur as part of the vulvo-vaginitis of children, in puerperal infections, in acute trichomonas infections, or in gonococcal infections, especially in children and pregnant women. All these conditions have been described.

CHRONIC VAGINITIS.—In its gonorrhœal form this condition has been described in the preceding chapter. In its non-gonorrhœal form it is a very common condition and is generally referred to under the term *Leucorrhœa*. Under this heading the condition has been discussed in Chapter XLIII (pp. 792-798).

SENILE VAGINITIS.—This condition occurs in elderly women where the infection is complicated by atrophic changes in the cervix and vagina. The disappearance of the Döderlein bacillus after the menopause (p. 866) favours the occurrence of infection. Red patches appear on the walls; some may ulcerate, and the ulcerated surfaces may adhere, thereby producing stenosis of the canal. There is a watery or purulent discharge which may become blood-stained. It is generally associated with a senile endometritis (p. 917), but sometimes the infection is confined to the vagina. Œstrone administration (p. 797) may be more helpful than antiseptic lotions. The senile vagina is better treated by bland lotions than by strong antiseptics.

GRANULAR VAGINITIS.—In some pregnant women a vaginal examination may disclose a peculiar roughened condition of the vaginal walls. On inspection the mucous membrane is found to be covered with numerous small, hard red-coloured nodules. There is usually a greenish-yellow vaginal discharge. The condition may, or may not, be due to gonorrhœal infection.

EMPHYSEMATOUS VAGINITIS.—In some cases of granular vaginitis

the nodules contain gas. The condition is occasionally encountered in pregnancy and is not necessarily due to a chronic gonorrhœal infection. The gas formation is due to the activity of an added bacillus, in most cases the *B. coli* or *B. Welchii*. Vaginal discharge is present, but there is little pain or discomfort.

MEMBRANOUS VAGINITIS.—This type of lesion occurs as an extension of a membranous or aphthous vulvitis (p. 885). *A true diphtheritic infection is very rare.* Scalding or caustics may cause a slough of the wall. The membrane may be shed in the form of a cast, but is usually discharged in small pieces. The symptoms and treatment are the same as in other vaginal infections.

TUMOURS OF THE VAGINAL WALLS

Vaginal Cysts.—Cystic tumours may arise from the vaginal walls from a variety of causes. In few cases does the cyst attain any great size. The point of origin is almost always the anterior or lateral walls, but is not so constantly in the middle line as is the case with solid tumours of vaginal origin. The cysts may originate in the lower part of Gärtner's duct (Fig. 359) (the representative of the embryonic Wolffian duct), from a portion of a Müllerian duct which has failed to unite, or from some other embryonic structure. While the normal vaginal mucous membrane contains no glands, one or two may be present as abnormalities and be the seat of cyst formation; the deeper layers of the vaginal epithelium may proliferate locally, and this, by central degeneration, may result in cyst formation. Dilatation of lymphatic vessels may give rise to a cyst. Portions of mucous membrane, which become closed in by adhesions resulting from a vaginitis, may become distended with fluid.

The cysts may be multiple and widespread over the walls, but single cysts are more common. The contained fluid is usually of a clear, serous character; occasionally it is blood-stained. In most cases the mucous membrane becomes so thinned out over the cyst that the tumour appears quite transparent. Symptoms seldom occur, unless the tumour becomes very large, when the patient may have the sensation of something "pressing down" or protruding into the canal. In rare cases the cyst may become infected or rupture.

Diagnosis does not present much difficulty, except where the cyst is situated in the middle line anteriorly and therefore resembles a cystocele. To establish a certain diagnosis in these cases, it may be necessary to pass a sound into the bladder, so as to ascertain exactly the relationship of the swelling to that organ. Should the cyst be situated in the posterior wall, a much rarer occurrence, a like difficulty may arise in making a differential diagnosis from a rectocele.

Small cysts which do not give rise to any symptoms do not require treatment. Larger cysts should be dissected out, though the dissection

may be troublesome in view of the extent to which the growth may have burrowed into the cellular tissues. Care must be taken to remove all the secreting epithelium, by use of the cautery if necessary, and to avoid doing injury to bladder, ureter or rectum.

Fibromyomata.—Benign solid tumours, arising from the vagina, are usually fibromyomata. They arise almost invariably in the middle line from the central longitudinal muscle columns of the anterior or posterior vaginal walls—more often the latter. The swelling is

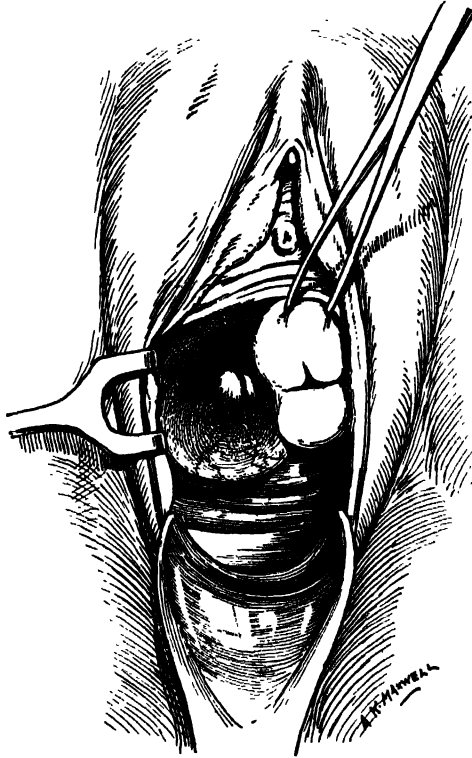


FIG. 359.—Vaginal Cyst (Gartner's Duct) seen to right of Cervix (vide Fig. 407) which is pulled down by volsella.

hard; it can be easily differentiated from prolapse of the uterus, or hypertrophy of the supravaginal portion of the cervix, by the position of the cervix *qua* the swelling. In distinguishing a fibromyoma of the anterior wall from a cystocele, it may be necessary to introduce a sound into the bladder.

The tumour can usually be removed easily; even in the sessile type it can be enucleated after incision of the capsule. In such operations great care should be taken to prevent injury to the bladder and urethra or rectum.

Carcinoma.—In the majority of cases carcinoma of the vaginal wall is *secondary to carcinoma of the cervix*. In carcinoma of the

cervix the direct spread to the vaginal wall may be very extensive, and form an important factor in determining treatment.

Primary carcinoma of the vagina of the squamous-celled epitheliomatous type may occur; it most commonly arises from the upper portion of the posterior wall (Fig. 360). It occurs in women at or after the menopause, but may occur in younger women in a very rapidly growing form. In older women it often escapes notice for a long time, as there may be little vaginal hæmorrhage and very slow growth.

The tumour usually arises as a flattened nodule on the vaginal wall, which gives place to an ulcer with indurated edges. This ulceration may extend over the wall in all directions; where it is

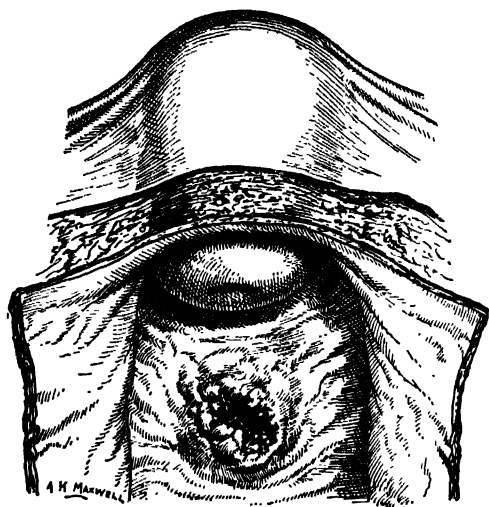


FIG. 360.—Primary Carcinoma of Posterior Wall of Vagina—the primary site is much more commonly in the posterior than the anterior vaginal wall.

more circumscribed a fungating mass may develop. In exceptional cases the induration may spread underneath the mucous membrane, which remains intact. Growth in depth may lead to the formation of fistulæ into bowel, bladder or urethra.

The *diagnosis* is usually easy, because, unfortunately, the lesion, in most cases, is far advanced when the patient thinks it necessary to consult a doctor. Where, in an early case, other lesions may have to be excluded, excision and microscopic examination of a portion of the tissue may be necessary. It is important to make sure that the vaginal growth is a primary one, and not secondary to carcinoma of the body of the uterus. *Treatment* is usually disappointing, because in most cases the tumour has extended in all directions, with involvement of the lymphatic system, before the patient comes for treatment. Excision of the growth is of little avail. The condition should be dealt with by radium and later deep X-ray therapy (*vide* Chapter LX).

Sarcoma.—This is an extremely rare type of vaginal tumour. It may occur in young children, where it may be first noticed as a growth appearing at the vulva. The type of tumour in children is usually the vesicular, resulting in the formation of grape-like masses, yellow-coloured fluid being contained in the cystic cavities; they arise from the cervix (*sarcoma cervicis botryoides* (p. 993)).

In adults the growth is usually diffuse, though it may take the form of an indurated nodule, which very soon breaks down, leaving an ulcerated surface with a copious hæmorrhagic discharge. In adults, as in children, the lesion usually begins on the anterior wall. The sarcoma may appear like a fibromyoma, but the rapid growth and the structure (microscopic examination) make the differential diagnosis simple. The type may be either round-celled or mixed-celled.

In both types of sarcoma in adults, the localised and the diffuse, the prognosis is very bad. Few patients recover. If a diagnosis be made early, a wide excision may be attempted, but treatment by radium is preferable.

Chorionepithelioma.—In most instances this neoplasm appears in the vagina as a metastasis from a primary growth in uterus. The tumour takes the form of a dark purple patch projecting above the surface and resembling very closely a thrombosed vein; it bleeds very freely. The histological appearances are the same as in the uterine form (p. 984). The purple patches are very characteristic; but in the primary form they may escape notice for some time, because there may be no uterine hæmorrhage to arrest attention. Where the growth is primary, it should be treated with radium or excised and the uterus should be curetted. If the endometrium thus obtained shows any sign of chorionepithelioma or the remains of a hydatidiform mole, the uterus and adnexa should be removed. The patients should be kept under most careful observation lest a recurrence takes place. Spontaneous disappearance of a metastatic lesion of vagina or vulva may occur after the performance of hysterectomy for uterine chorionepithelioma, but a course of deep X-ray therapy should be employed following removal of uterus.

Endothelioma.—Endotheliomata, both primary and secondary, have been described as occurring in the vagina. The secondary form is usually associated with a uterine lesion. Clinically, this tumour cannot be distinguished from carcinoma, and even the microscopic appearances are very similar. Treatment should be carried out on the same principles as for carcinoma of the vagina.

INJURIES OF THE VULVA AND VAGINA

Most cases of injury to the vulva or vagina occur during labour, and their causation and immediate treatment have been described in Chapter XXXIV (p. 591). There are, however, a number which are

either completely neglected or inadequately treated at the time of the occurrence of the injury, and which present themselves for treatment at a much later date. A small proportion of cases of injury to these organs occurs apart from labour.

INJURIES TO VULVA AND VAGINA WHICH DO NOT RESULT FROM LABOUR.—The vulva may be severely damaged as the result of either a fall or a blow. Hæmorrhage may be very profuse, or a large hæmatoma may occur.

Injuries may occur during coitus, especially in the lower narrow part of the canal; in such the tear usually occurs in the posterior or lateral walls. A few cases have been recorded in which laceration of the posterior fornix has occurred with penetration into the cellular tissue. It has been recorded that even the pouch of Douglas has been penetrated. The most serious injuries of this type are found in cases of rape in young children, where the rectum has been torn or the vagina torn from the cervix.

Injuries to the vaginal wall may be caused by ill-fitting pessaries or other foreign bodies, under the conditions already referred to.

Extensive damage may be produced during attempts at criminal abortion by a sharp instrument, which the patient or an accomplice, in attempting to pass into the uterus, has pushed through the vaginal vault. In many such cases peritonitis results (p. 1040).

INJURIES TO THE VULVA AND VAGINA PRODUCED DURING LABOUR.—The production of a hæmatoma during labour has been referred to (p. 606).

Perineal Lacerations.—These injuries, their classification and their immediate treatment have been described (p. 593). Where such injuries have been neglected at the time of their occurrence, and present themselves for treatment at a later date, they may still be divided into *first*, *second* and *third* degree perineal tears. The seat of injury is usually covered by stratified, squamous epithelium or scar tissue. The abnormal exposure of the vaginal canal so produced is often associated with a catarrhal vaginitis. The loss of the support of the perineum favours the development of cystocele (p. 843). In cases of complete tear there is incontinence of fæces; but in cases where a thin strand of sphincter ani remains, there may be incontinence only if the motions are loose. The patient may have a feeling of want of support, but that complaint is usually associated with prolapse of the uterus or vaginal walls. A considerable degree of tearing of the perineum may be present without the patient experiencing much discomfort. On the other hand, in a few cases there may be a feeling of local discomfort, associated with an apparently intact perineum; here it may be found that the perineum consists of skin and scar tissue only, and that the levatores ani have been widely separated or torn asunder.

The appearances in all cases of perineal tears are unmistakable.

The vaginal walls, with their transverse rugæ, are exposed to view. In cases of *complete tear*, the position of the retracted ends of the sphincter ani can be identified by the presence of small dimples in the skin at each side of the opening (Fig. 361(3)). Then, too, the different appearances of the pale vaginal epithelium and the reddish rectal mucous membrane can be appreciated.

The operations employed in the repair of these old-standing injuries of the perineum are described in the section dealing with gynæcological operations (p. 1093).

The middle, but more commonly the upper third, of the vaginal canal may be injured during parturition. Tears beginning in the

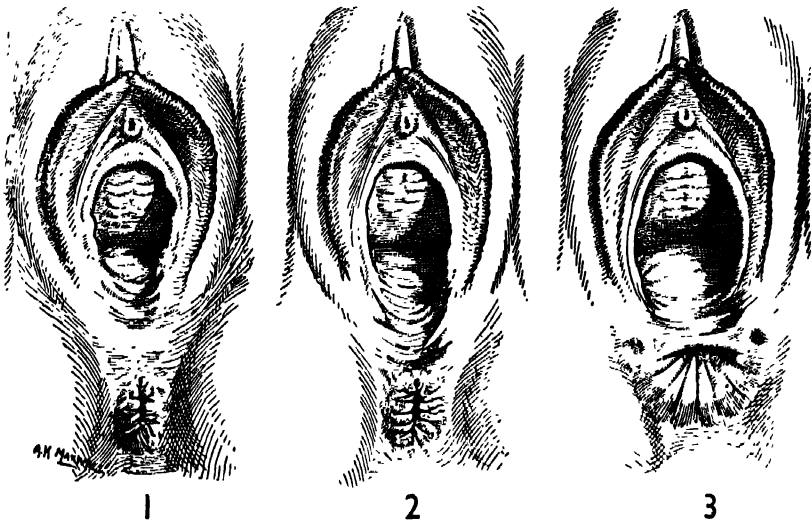


FIG. 361.—Degrees of Perineal defect where the Primary Laceration has healed.

cervix may extend into the vaginal vault (p. 597). These injuries result in the formation of cicatricial bands, which may produce very little discomfort, though they sometimes anchor the cervix in such a way as to cause a change in the axis of the uterus. While these bands produce little discomfort, they are often associated with chronic infection of the lacerated cervix and of the utero-sacral ligaments. Excision of these scars, when they cause discomfort, may not prove very satisfactory—the cicatricial deformity may be increased. Cicatrices in vagina may cause dystocia in a subsequent labour and necessitate Cæsarean section (p. 719).

Fistulæ between vagina and bladder, urethra or ureter and between vagina and rectum have been already described (p. 604).

CHAPTER XLVII

DISEASES OF THE UTERUS

INFLAMMATORY AFFECTIONS OF THE UTERUS

Cervicitis—Endometritis—Metritis

GENERAL ÆTIOLOGY

INFECTION of the uterus may be derived: (1) from the blood-stream; (2) from above; or (3) from below.

(1) *Blood-stream infection* is relatively uncommon and is rarely of clinical importance. It occurs in such conditions as the specific fevers, scarlet, diphtheria, typhoid, etc., in the rare cases in which pelvic *tubercle* has its first nidus in the uterus (p. 879), and in the multiple pus foci of pyæmia.

(2) *Infection from above* occurs either by a spread from inflamed tubes or by a direct spread of infection through the uterine wall from bowel, as in appendicitis, diverticulitis, or malignant disease. The most common type of this descending infection is tuberculosis, which commences in the tubes and thence spreads to the uterus.

(3) *Infection from below* is by far the most important avenue. It comprises *infection in association with labour or abortion* and *gonorrhœa*, which, between them, embrace the majority of uterine infections.

In acute puerperal infection, which occurs after abortion or labour, the causal factors may be many. These are discussed fully in a preceding chapter (Chapter XXXVII). From the gynecological standpoint it is important to recognise that an acute puerperal infection frequently persists as a chronic lesion. At the same time many chronic uterine infections may originate in childbed or after abortion without there being any evidence of an acute onset such as pyrexia. This is especially true of the common chronic cervicitis dating from the trauma of labour.

Gonorrheal infection and its acute manifestations are considered in Chapter XLV.

In *postoperative inflammation*, and inflammation engrafted on degenerating *tumours*, such as cancers, and fibroids, the infection is derived from below. In some rare cases, the organisms of the *specific fevers*, typhoid, pneumonia, diphtheria, etc., may reach the uterus from below. *Pessaries* predispose to uterine infection by trauma and infection of the vaginal walls, such infection being constantly available to spread

to the uterus. The risk is greater if the pessary is ill-fitting, if not kept clean by periodic douching and if, in addition, it is not removed at regular intervals for cleansing.

Inflammatory affections of the uterus constitute a large and important group of gynæcological disorders. We propose, therefore, to deal with them in considerable detail. A convenient subdivision for purposes of description is as follows :—

1. Inflammation of the Cervix : Cervicitis.
2. Inflammation of the Body : (a) Endometritis, (b) Metritis ;

but it should be remembered that there is no anatomical barrier to the spread of infection from one region of the uterus to another.

INFLAMMATION OF THE CERVIX

The cervix is specially prone to infection because of its relationship to the vagina. Normally, above its level the genital canal is sterile, but below it organisms are present and, while under ordinary circumstances such organisms are not pathogenic (see "Vaginal Protection," p. 866), they may become so, or pathogenic organisms may be introduced—*e.g.* the gonococcus. Facilities for lodgment and protection to organisms are provided at the external os by the delicate pouting mucous membrane of the canal or by crypts and lacunæ so commonly present on the vaginal surface of the cervix (Erosion). The erosion due to infection provides a suitable nidus for constant re-infection. The delicate columnar epithelium, apart from its propensity to form crypts to harbour infection, is very vulnerable and is in a foreign environment. Nature designed that the vaginal cervix and vaginal canal should have full protection, hence the stratified squamous epithelium without glands or other means of harbouring infection.

A feature of infection of the cervix is that organisms may remain latent for long periods and eventually, if the body resistance is lowered, flare up or infect the higher levels of the tract.

A further fact of importance is that in the presence of infection there is necessarily a tendency for the swelling of the tissues to block the cervical canal and thus to prevent adequate drainage of the inflammatory discharges, not solely by occluding the canal itself but also by obstructing the escape of secretion and exudate from the glands opening into the canal. It is in these structural peculiarities that we find an explanation of the proneness for an infective lesion of the cervix to show little tendency to spontaneous cure. There is probably no region in the body to which this applies as much as to the cervix. The tonsils and the cranial sinuses, once they become infected, exhibit a similar tendency towards chronicity, and here, again, the dominating factor is inadequacy of drainage. From these analogies the cervix has sometimes been called "the pelvic tonsil." The analogy is not strictly correct as there is not any lymphoid tissue in the cervix.

and, when thus exposed, may closely simulate "erosion"—very often both conditions are present.

Microscopically a piece of tissue removed shows hyperæmia and round-cell infiltration. On the surface, the stratified epithelium has been replaced by columnar epithelium. This epithelium dips down from the surface to form crypts and glands which have a distinct tendency to cystic distension. These frequently lie under the apparently healthy stratified squamous epithelium. It is not uncommon to find stratified squamous epithelium covering the surface and merging with columnar epithelium at the mouth of a crypt. There is a constant

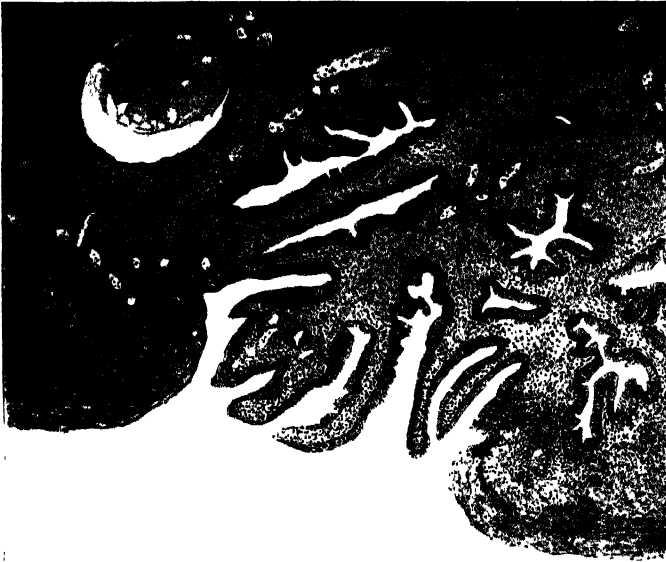


FIG. 362.—Erosion of Cervix. Showing also a Cystic Space.

striving between the two types of epithelium, that of the vaginal surface and that of the canal, to cover the area so that the erosion is not stationary. Where cystic spaces are found under apparently normal squamous epithelium they may have formed at a time when the surface was covered by the columnar variety and their presence and progressive distension may assist in again removing the squamous covering to be replaced once more by the columnar (Fig. 362).

Nabothian Follicles are an evidence of chronic inflammation of the cervix and frequently accompany erosion. They are small tense cysts, roughly about the size of a pea, which bulge, glistening on the vaginal aspect of the cervix. They are filled with a viscid mucus and are lined by columnar epithelium; in the larger cysts the epithelium is flattened. They originate from glands of the cervix, whose mouths have been occluded by the chronic inflammatory changes. They are

thus retention cysts which have expanded towards the vaginal aspect. In some cases they become polypoidal, and hang into the vagina by a narrow neck. They may simulate the hard nodular condition of an early localised carcinoma, but the diagnosis is cleared up at once if they are pricked with a knife, when the viscid contents will be expelled.

CLINICAL FEATURES AND DIAGNOSIS OF CHRONIC CERVICITIS.—The most constant symptom is discharge from the vagina. Pain in the pelvis or abdomen is the next most common local symptom. Bladder and menstrual troubles are frequent, and the general health may be involved in a variety of ways—fatigue, headaches, arthritis and cardiovascular disturbances being amongst the most frequent manifestations.

Discharge.—This consists of a more or less persistent vaginal discharge, sometimes thin and watery, more often thick and creamy, and sometimes frankly purulent. It is prone to irritate the mucous and skin surfaces of the vagina and vulva and cause pruritus (p. 888).

Pain.—Apart from discharge the most disturbing of the common symptoms of cervicitis is pain, which is felt usually in the lower abdomen and more especially in one or other iliac fossa or in both fossæ. On occasion the pain is situated in the flank or in the upper abdomen, whilst not infrequently it is situated low in the back in the sacral or coccygeal regions; pain in the hip and thigh would seem sometimes to owe its origin to cervical disease. In many instances there is discomfort or even acute pain during the action of the bowels; this is especially common in cases with a secondary utero-sacral cellulitis. All those aches and pains are prone to exaggeration before *and during* the early phase of menstruation (*premenstrual dysmenorrhœa*, p. 800) and as the result of exertion.

To understand the method by which the origin of such cervical pain is diagnosed, we have to consider some simple facts in connection with an ordinary vaginal examination. If the examining fingers are placed on the cervix and this be moved laterally, antero-posteriorly, or upwards, it is found that in health a considerable amplitude of displacement can be obtained in all these directions, and that even at its maximum this displacement is painless. In cases of cervicitis, on the other hand, this mobility is commonly restricted, and in those cases in which pain is present, any attempt to displace the cervix at once provokes the symptom in the situation in which it has been complained of by the patient, be it in the iliac fossa, the back or the bowel. On occasion, pain may be elicited by manipulation of the cervix, although such pain does not appear among the symptoms of the case. In many instances the least pressure on the cervix causes severe pain—the type of case in which *dyspareunia* is apt to be a particularly distressing symptom. In not a few patients in whom *nausea* is a prominent clinical feature in the history, a tendency to retch is at once provoked by this procedure—an interesting demonstration of the widespread reflex nervous phenomena that may owe their origin to the genitalia.

Because of its wide distribution the pain of cervical origin is apt to be a source of confusion in diagnosis. Tubal or ovarian mischief is often erroneously suspected; in the presence of a uterine displacement the pain may easily be attributed to this; whilst a common source of confusion arises from right iliac fossa pain being mistaken for appendicitis.

The diagnosis in such cases rests (1) on the presence of vaginal discharge; (2) on the dating of the symptoms from a preceding abortion or childbirth or a gonococcal infection; (3) on the pain response evoked by movement of the cervix; and (4) on the absence of the characteristic features of tubal infection, appendicitis, etc. In doubtful cases an examination under anæsthesia may be necessary to exclude tubal disease. It is important to remember that chronic cervicitis may be complicated by the presence of tubal infection, and it is imperative that treatment should be directed to both conditions.

Erosion, from the appearance of its surface and the fact that it sometimes bleeds on examination or on gentle swabbing or scraping, *may simulate epithelioma*. The mere introduction of a speculum, if its upper edge comes in contact with the area, may cause a little bleeding. Hardness due to fibrosis, and the nodular condition associated with distended follicles, may lend further colour to suspicion of malignancy. In any doubtful case a portion of tissue should be removed for microscopic examination. The differential diagnosis from a *primary syphilitic sore* is described elsewhere (p. 875).

TREATMENT OF CHRONIC CERVICITIS.—As chronic infection of the cervix is frequently a legacy from child-bearing, the ideal time for its recognition and treatment is during the postnatal period—that is, before it has succeeded in producing the deep-seated structural changes and the train of local symptoms and general ill-health which characterise so many cases (*vide* p. 637). *One of the strongest arguments in favour of a postnatal examination of every woman at the end of four or six weeks is the opportunity it gives for the detection of this lesion at an early stage and when, if not curable by easy methods, at least the sequence of effects of its presence can be prevented.*

We have seen that the dominating feature of the lesion is its chronicity, and that this in turn is dependent upon the peculiar structural arrangements in the cervix which tend to a locking up of the inflammatory discharges. This gives the key to the treatment which must be directed to the opening up of the cervical canal and the establishment of tracks in the cervix along which the pent-up exudates can drain away freely. For these reasons, active surgical measures are essential. Experience has shown that the application of caustic or antiseptic medicaments, which have been employed in the past, succeed in effecting at the best nothing more than a temporary cleansing of the vagina, whilst at the worst they may do harm by damaging the mucous membrane and tissues and in this way aggravate the inflammatory

processes already present. Recently, the introduction into the cervical canal of candles or stalks of material impregnated with zinc chloride (Bourne, Bond, M'Garritty, *B.M.J.*, 16th January 1937) has been recommended. The advantages and greater safety of this method have still to be proved. Long ago this principle of treatment was employed for cancer of the body of the uterus, but has been superseded by hysterectomy or radium therapy. For chronic endocervicitis it has still to be shown superior to that now to be described. One objection to it is that it will not influence ectropion, deep laceration or extensive erosion of the cervix, one or all of which may accompany the endocervicitis.

When the cervix is angry looking and oedematous, due to temporary exacerbation of the inflammatory process, rest in bed and vaginal douching, properly carried out, is a valuable procedure preparatory to more active measures. It is unwise to proceed with operative treatment until the acute condition has subsided, as it usually does in from ten to fourteen days. This period of rest in hospital or nursing home under proper régime often produces an astonishing improvement both in the local and in the general condition of the patient and increases resistance. Bacteriological examination may be carried out during this period. Smears from the cervical canal and of the vaginal discharge are examined for specific organisms. If there is a superadded trichomonas or other vaginal infection discovered this must be cleared up before any further procedure is carried out (see p. 798).

In all cases, except those to be subjected to hysterectomy, dilatation of the cervix is an important part of the treatment, since it is in this way only that the interior of the cervical canal can be made accessible for treatment and later permit of free escape of exudate and discharge from this area. Curettage is contraindicated unless there is a separate indication. Sometimes it is wise to explore the uterine cavity, but this must be justified from the history or physical findings for there is always the possibility of carrying infection to the uterine body. There is not any treatment suitable for all cases of chronic cervicitis. Each case requires individual consideration. As a guide to choice of treatment cases might be classified thus.

1. *Without Cervical Laceration, with or without "Erosion" (over 50 per cent.).*—Treatment is directed to establishment of drainage and destruction of the superfluous glandular elements in the cervix and especially those which have undergone cystic distension. This is best achieved by *diathermy*, coagulation current. Good results are obtained by the Paquelin or electric cautery, but diathermy is simpler of application and produces less local reaction. An electrode of about 3 mm. breadth and sufficiently long to allow it to be applied to the cervical wall from internal os to external os is employed. After dilatation of cervix to the full extent short of tearing, this electrode is applied longitudinally to the cervical wall at four or six equidistant places. As bleeding sometimes results it is wise to start posteriorly. When

bleeding is troublesome either during the application or as a result of the dilatation, a plug of sterile gauze may be introduced and retained in the cervical canal while the diathermy treatment is being carried out. The longitudinal lines of coagulation are continued out on to the "erosion" if such is present. In addition to destroying gland tissue this procedure results in a rolling in towards the canal of the eroded area when the lines made cicatrise in the course of healing. The best results are obtained when no columnar epithelium is left exposed to the vagina. Any cystic glands are punctured and destroyed by coagulation, and even if they are not obviously present to the naked eye it is advisable to pass the electrode into the substance of the cervix between the lines marked out over the area of erosion. In most cases one is surprised at the number of small cystic spaces punctured and destroyed, as evidenced by the escape of coagulated mucus.

Instead of simple coagulation in lines along the wall of the cervical canal it has been advocated that longitudinal strips of the wall of the canal be removed by a small ring electrode stroked from the internal to the external os. The principle is the same.

Whether by diathermy or by cautery the application must not be overdone so that excessive cicatrization is produced. Beyond reasonable limits a shrivelled fibrous cervix may result and be responsible for dysmenorrhœa, or, if pregnancy occurs, rigidity of the cervix with difficult labour.

Diathermy treatment gives most gratifying results, and requires only a very short stay in bed—five to seven days. There is very little general disturbance so that convalescence is rapid. In comparison with non-operative measures it is an economy in hospital beds. There is no postoperative pain. When pain has been present before operation this often disappears immediately or soon after operation and, before the patient leaves hospital or nursing home, the pain elicited by manipulation of the cervix has disappeared. Discharge is not arrested immediately. Until the devitalised tissues have separated and the areas are completely healed discharge is present in gradually diminishing amount. Very rarely, the separation of sloughs produces bleeding about the tenth or twelfth day. It is most exceptional for this to be of serious moment if the treatment has been carried out in the manner described. Such secondary hæmorrhage is much less frequent and less serious than that following repair or amputation of the cervix. A correspondingly shorter stay in hospital or home can therefore be confidently promised.

2. *With Cervical Laceration (and Ectropion).—*

(a) Without generalised hypertrophy of the cervix. Emphasis has been placed on the importance of radical treatment leaving no columnar epithelium exposed to the vagina. Ectropion is an inevitable accompaniment of laceration. After dilatation of the cervix repair of the laceration should therefore be carried out. The edges of the tear may

be removed by a diathermy electrode with "cutting" current and then sutured; but equally good or better results are obtained if carried out in the ordinary way with a knife (Chapter LV).

(b) With hypertrophy of the vaginal cervix, so often encountered when lacerations are extensive or multiple and sometimes even when they are not, it is definitely advisable to perform amputation. The broadened, hard, knobby cervix, often containing many cystic spaces situated deeply, is beyond the scope of diathermy or cautery. Changes are deep seated and general and this type merges into the next in which hysterectomy is the correct procedure.

3. *With Laceration, Hypertrophy (and Chronic Metritis).*—Where the cervix is greatly enlarged and deeply disorganised and where the inflammatory process has produced widespread changes, its effect will not have been limited to the cervical portion of the uterine wall. Almost certainly there will be changes in the wall of the body of the uterus, with menstrual disturbances if the patient has not passed the menopause. The entire uterus is unhealthy and should be removed. Total hysterectomy by the abdominal route or, if practicable, by the vaginal route should be performed—there is much to be said for vaginal hysterectomy in this particular condition.

INFLAMMATION OF THE BODY OF THE UTERUS

Endometritis

Endometritis, or inflammation of the mucous membrane of the uterine body, may be (1) acute or (2) chronic. The succeeding remarks on chronic endometritis should be read along with those on metropathia hæmorrhagica (p. 788).

Acute Endometritis.—*Puerperal endometritis* (p. 643) was a term often applied indiscriminately to all cases of infection during the puerperium. The infected area, however, might have been the perineum, the vagina or the cervix. With a better appreciation of the possibility of infection at these levels and exclusion of such, even when the infection is limited to the uterus, the term is not appropriate. With the birth of the placenta and membranes the greater part of the mucosa is shed, and infection of the uterus if it does occur is not limited to the thin layer of decidua still present. The changes characteristic of inflammation, œdema, hyperæmia, exudate and leucocytic infiltration extends to a varying depth outwards into the myometrium. Also, organisms will be found beyond the limits of the mucous membrane. Discharge from the uterine cavity is not a product solely of the remaining decidua but is contributed to by the inflammatory exudate originating from the affected myometrium. Acute inflammation of the uterine mucosa must therefore imply a degree of involvement of the muscle layer of the wall. There is no anatomical barrier to such involvement between the two layers. The converse is also true. The consideration, therefore,

of acute inflammation of the endometrium and myometrium (metritis) separately is for purposes of description only, and their inevitable association must be borne in mind. Actually if infection is restricted to the mucosa or mainly so the condition is not serious, it becomes serious only when it extends directly to the myometrium or the Fallopian tubes, or by embolic process to other regions. With the exception of puerperal and gonorrhœal infection acute endometritis is surprisingly rare. It may occur from faulty operative technique, necrotic fibromyoma, cancer, contraceptive appliances introduced into the uterus, etc. Probably it is seen in its truest form in senile endometritis.

Gonorrhœal endometritis is practically always a direct extension from the cervix and this may occur in the puerperium (p. 640). There is little general disturbance and the stage of involvement of the endometrium frequently escapes notice clinically. Only when the tubes are involved are features of clinical significance produced. In the ordinary non-puerperal variety of gonorrhœal infection, the myometrium is either not invaded at all or only to a very slight extent : but opportunity of examining the endometrium is seldom presented.

SYMPTOMS AND SIGNS.—The symptoms and signs of acute *puerperal infection* are discussed in Chapter XXXVII (p. 645).

In *gonorrhœa* the involvement of the endometrium may give no other signs than those already present, due to cervicitis. The first clinical evidence of the upward spread of the disease usually does not appear till the abdominal pain of tubal inflammation develops.

The symptoms and signs of an infection *after operation* consist of a rising pulse and temperature, with the escape of a muco-purulent uterine discharge. There may be abdominal pain and tenderness over the pubes. One of the most anxious experiences in gynæcology is encountered when the operation of curettage is followed by an acute streptococcal infection. Uterine discharge is not a feature. It is a very grave complication and is associated with marked constitutional disturbance. This usually indicates invasion of the blood-stream (septicæmia) and calls for prompt and energetic treatment. In the sulphonamides we now have a valuable and more hopeful weapon of defence than formerly (p. 653). Fortunately this complication is rare.

Submucous *fibroids which become septic* produce pain and a foetid discharge. There usually is an increase in the size of the tumour. In *carcinoma* and other forms of malignant disease the discharge and hæmorrhage are largely due to an associated infection. Senile endometritis is considered in its chronic form later.

TREATMENT.—For the treatment of *puerperal* cases the reader is referred to Chapter XXXVII (pp. 650-655).

In *postoperative* cases an autogenous vaccine should be prepared, and treatment similar to that employed in acute puerperal sepsis should be instituted. If suspected to be of streptococcal origin, sulphanilamide should be administered.

In the case of *degenerating tumours* the removal of the growth is the only remedy. In advanced *carcinoma*, scraping away the main mass of the growth, the application of strong antiseptics and the employment of radium and X-rays are the methods of treatment available.

Chronic Endometritis.—Certain appearances, naked eye and microscopic, formerly regarded as evidences of chronic inflammation of the endometrium are now no longer accepted. Reference to this will be made in discussing the so-called "Glandular Endometritis." With increased knowledge of the ductless glands and their influence on the endometrium the number of cases now labelled "Chronic Endometritis" is only a fraction of what it was at one time. In a series of 8500 gynæcological cases, a diagnosis (on histological evidence) of "Chronic Endometritis" was made in 338 cases (less than 4 per cent.), and this is probably an overestimate. Two types are quite definite entities and merit separate mention; these are Senile Endometritis and Tuberculous Endometritis. In both there is clear proof of chronic inflammation microscopically, and both are relatively rare conditions.

SENILE ENDOMETRITIS is an infective condition of the endometrium affecting women after the menopause. Its *ætiology* has been already described (p. 866). It is encountered in about 0·2 per cent. of admissions to gynæcological wards. An acute phase is not recognised. The thin atrophic endometrium loses any glands that may have been present and also the surface epithelium. What stroma was present is replaced by granulation tissue set directly on the myometrium. Plasma and small round cells are numerous and invade the myometrium to some distance. This layer produces a thin, watery, highly irritant exudate which eventually brings about changes in the vaginal wall (senile vaginitis) and, at the vulva, pruritus of varying degree. Small vessels in the granulation tissue bleed periodically and make the discharge blood-stained. As the condition advances slowly it is usually only when blood appears that medical advice is sought. The possibility of a malignant neoplasm being present is a reasonable fear and a diagnosis must be made. This is done by exploration of the interior of the uterus.

In a proportion of cases the atrophic cervix interferes with drainage from the uterine cavity and the cavity distends with purulent exudate. To this condition the term *pyometra* is applied. With accumulating pus in its interior the distension of the uterus in an elderly subject results in a thinning of the wall. This should be remembered if it be encountered at laparotomy. Such a uterus will not stand the application of volsellæ without tearing of its wall and probable spilling of pus.

The *symptoms* of senile endometritis are those already mentioned, viz., thin, irritating, watery discharge not great in amount with bad odour and occasionally blood-stained. *Treatment* consists of dilatation

of the cervix, and disinfection of the interior of the uterus by the application of acriflavine and glycerine (1 in 500). If there is pyometra, preliminary drainage of the cavity is necessary. Very great caution must be observed if curettage is employed for this condition. If disinfection is unsuccessful the alternative is hysterectomy, preferably, when possible, by the vaginal route; but as the subjects of this condition are often elderly, the risks of a major operation are great. Œstrone therapy (p. 797) should be given a trial before recourse to hysterectomy.



FIG. 363.—Tuberculous Endometritis.

TUBERCULOUS ENDOMETRITIS is associated with a thickening and later with a caseation of the mucosa (p. 879). The tubercle follicles may be recognised as pale foci visible to the naked eye. Usually, however, they are only detected on microscopic examination (Fig. 363). Proof of tuberculous infection of the endometrium was found in less than 0.1 per cent. in a large series of cases. In exceptional cases the infection is derived from below, as, for instance, where the woman is infected at coitus. Tuberculous endometritis usually results from direct extension from tuberculous tubes. The site in which the disease is specially focused is therefore the mucous membrane near the uterine cornua. A nodular thickening in this region formed partly in the

wall of the uterus and partly in the tube is not infrequent in tuberculous salpingitis (nodosal salpingitis, p. 1032).

The *symptoms* may include persistent leucorrhœa and hæmorrhage. Amenorrhœa is present in a considerable number of cases. This indicates involvement and destruction of the ovaries. Mostly, tubal (and ovarian) involvement is extensive and overshadows in its symptoms the uterine element. *Treatment* necessitates a wider consideration than merely the uterine lesion. There is, almost without exception, tuberculosis of the tubes, and probably of the pelvic peritoneum or of the peritoneum generally. Sanatorium treatment replaces operative procedures when the disease is not strictly localised. When a diagnosis of tuberculosis of the endometrium is made after examination of curettings it should be taken as a serious warning against operative treatment until the patient has undergone a thorough general examination.

ORDINARY CHRONIC ENDOMETRITIS.—Turning now to consideration of chronic endometritis in general, excluding the two definite types already dealt with, the matter becomes much more difficult.

Curetting of the uterus became popular when little of the histology or pathology of the endometrium was known. Bulky endometrium when obtained was assumed to be the result of inflammation—chronic inflammation produces hyperplasia and hypertrophy, therefore chronic endometritis was a frequent diagnosis. Histological study of curettings, however, raised doubt as to these changes being due to inflammation (infection) and the trend of opinion veered to neoplasm of the endometrium. *Simple adenoma* was the term which was for a time employed to signify thickening of the endometrium in which definite proof of inflammation could not be provided. This implied the recognition of it as of neoplastic origin. The next step was the discovery that hypertrophy and glandular hyperplasia were natural attributes of the endometrium of the body of the uterus, in the *pre-menstrual phase*. Lastly, the influence of the internal secretions, nearly all of which are accepted as having effect on the menstrual cycle and influencing changes in the endometrium, was recognised.

At one time the most common diagnosis in gynæcological practice was "Chronic Endometritis." Now, as already stated, if the diagnosis is made on histological findings, less than 4 per cent. of patients admitted to gynæcological wards can be shown to furnish proof of the presence of this condition.

Bearing in mind the controlling influence of the secretions of the ovary and pituitary, and of the other endocrine glands which effect their influence, it is not surprising that the correct interpretation of the microscopic appearances of the uterine mucosa is difficult and has been often misleading. In addition, this structure, the histology of which has presented so much difficulty during reproductive life, sheds a good part of itself each month and this confuses the issue. Changes characteristic of chronic inflammation take time to show themselves.

There is not time for this in an endometrium which is rejuvenated each month. When this constantly changing picture ceases (after the menopause) we are enabled to recognise a clinical and pathological entity, "Senile Endometritis," which has been described (p. 917). Proof of chronic inflammation cannot be furnished by glandular proliferation. Glands consist of a cavity lined by a single layer of columnar epithelium. Inflammatory change cannot be recognised in a single epithelial cell or in a single layer of these cells. Glandular proliferation might be accepted as contributory evidence of chronic inflammation in any organ, but not as proof. This is especially true as regards the mucosa of the corpus uteri.

As textbook classification is still that of Glandular and Interstitial Endometritis it may be advantageous to explain that in the former the stress of the change affects the glands (proliferation which, as stated, is not necessarily an evidence of inflammation), and in the latter, the stress falls on the stroma. Undoubtedly there are different appearances produced, but there is not evidence to support the usual subdivision into types.

In *chronic glandular endometritis* the glandular elements of the mucosa are increased. The interstitial tissue may be unaltered or may show proof of inflammatory reaction by the presence of plasma cells in excessive number. Differential staining (methyl-green-pyronin) is most useful in demonstrating this. In addition, vessels with thickened walls (normal vessels in the endometrium are capillary in type (p. 18)) may be found and patchy areas of fibrosis of the stroma are encountered, especially in relation to the altered vessels. This change from the less mature type of cell normally forming the endometrial stroma to the adult type of fibrous tissue cell is recognised by the different intensity of staining. Small round cells are normally present in the endometrium and unless present in excess and diffusely distributed cannot be taken as furnishing evidence of chronic inflammation.

Even in the absence of structural alterations in the ovaries, which might indicate an endocrine cause for glandular hyperplasia of the endometrium, one is not justified in accepting that such influence is absent when proof of chronic inflammation is found in the interglandular tissue. That is to say, the glandular changes may be independent of the inflammatory changes present, although there may be a strong inclination to attribute them to a common cause. Endocrine dysfunction does not necessarily mean clinically recognisable alteration in structure. This matter is discussed in another chapter, p. 787.

The increase in thickness of the endometrium may be very marked. It may exceed half an inch in thickness. The surface is corrugated. Localised projections tend to occur, especially if cystic distension of glands takes place (formerly designated "Polypoidal or cystic Endometritis").

The uterus tends to extrude any localised projection, and the result is the formation of *mucous polypi*. Sometimes the surface assumes a papilliform arrangement. This was called *villous endometritis*. In all cases where the glandular proliferation is marked, the glands are tortuous, and infolding of the epithelial layer is found. This may be simulated by oblique sectioning. It may be difficult to exclude malignancy (malignant adenoma) by examination of curettings (p. 976).

The stroma of the endometrium, apart from other evidence of inflammation, is œdematous, and areas of interstitial hæmorrhage are

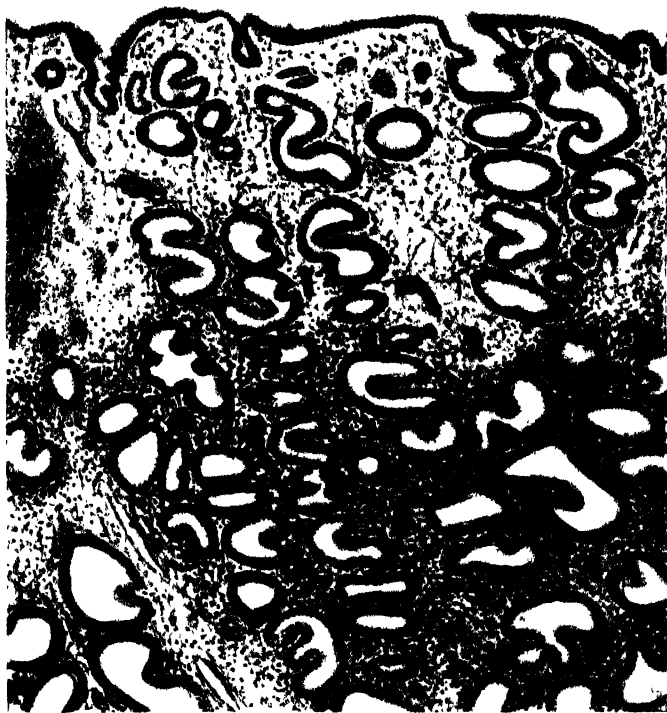


FIG. 364.—So-called 'Chronic Glandular Endometritis.' (Compare with Fig. 321, p. 789.)

common. Isolated areas of necrosis may be seen. Apart from increase in size of the uterus due to the bulky endometrium, enlargement may be due to true overgrowth of the uterine musculature (myohyperplasia). This no doubt is to some extent stimulated by the bulky endometrium.

Excluding the two definite entities, senile endometritis and tuberculous endometritis, *chronic interstitial endometritis* is reserved for cases in which glandular hyperplasia is not a feature or at any rate not a marked feature. The features are the changes characteristic of chronic inflammation, as already described, in the endometrial stroma, and a relatively thin endometrium. It may be a sequel to an acute endometritis after labour or abortion, but the acute phase may be (as it

also may be in gonorrhœal infection and infection in connection with degenerating tumours such as submucous fibroid, mucous polypus, etc.) very unobtrusive.

In the microscopic examination of the endometrium it is important that the stage of the menstrual cycle be known and kept in mind. When the material is obtained with the curette, if it is obtained shortly after menstruation, there is less likelihood of confusion arising on account of the glandular picture as the premenstrual changes are eliminated.



FIG. 365. — A Chronic Endometritis showing Constriction of Glands by Stroma of Endometrium.

CLINICAL FEATURES OF CHRONIC ENDOMETRITIS.—Chronic endometritis is very frequently associated with chronic cervicitis and it may be difficult to assess the clinical features separately in any one case.

Non-hæmorrhagic vaginal discharge in such cases has its origin mainly from the cervix, but if the disease is more widespread and involves the myometrium, discharge may also come from the body. Usually there

is efficient drainage from the uterine cavity; any exudate escaping readily. This reduces absorption and therefore general symptoms.

With a thickened endometrium there will be *profuse menstruation*. Should localised projections of the mucosa exist, intermenstrual bleeding is probable and may be severe.

Pain in the back and lower abdomen, aggravated at the menstrual periods, may be present without other attributable cause, but definite pain and dysmenorrhœa should arouse suspicion of the presence of disease of the tubes and possibly ovaries which commonly accompanies endometritis. Sterility is a usual result of a diseased endometrium. When the infection is due to a necrotic tumour, a foul-smelling discharge is added and overshadows the above symptoms.

On bimanual examination there is little to be discovered. The uterus is usually slightly enlarged. The commonly associated cervical lesions may be found, and careful note of the condition of the tubes and ovaries should be made as chronic salpingo-oöphoritis is often a sequel of endometritis. A definite diagnosis rests on the recognition of inflammatory reaction in a portion of endometrium removed for microscopic examination.

When chronic endometritis has as its chief symptom uterine bleeding it has to be differentiated from the following conditions :—

Retained Placental Fragments.—These cause hæmorrhage and pain dating from a miscarriage or labour. Curettage is the only means of clearing up the diagnosis.

Fibromyomata.—They are excluded by the usual methods of examination. Endometritis, of course, often complicates fibromyomata.

Carcinoma and other Forms of Malignant Disease.—They are excluded by curettage if digital examination fails to reveal the existence of the friable and bleeding surface of a cervical neoplasm. In most cervical cancers and in a corporeal growth, when it is advanced, the vaginal hæmorrhage is accompanied by a foul-smelling discharge.

Salpingo-oöphoritis.—This condition may be associated with endometritis, and the major symptoms may be due to the tubo-ovarian inflammation. For these reasons a careful bimanual examination of the appendages is necessary in all cases.

TREATMENT.—In a case in which there is non-hæmorrhagic discharge from the uterus and the cervix and cervical canal can be exonerated as the source, which is seldom, swabs should be taken from the cavity of the corpus and examined bacteriologically. To prevent contamination from the wall of the cervical canal special precautions are necessary. If a definite causative organism is found an autovaccine may be tried, and the uterus disinfected.

Usually, however, the case is one in which profuse menstruation is the outstanding feature and the interior of the uterine body is sterile. Curettage is necessary for diagnosis and if this, together with the introduction of an antiseptic such as tincture of iodine or carbolic acid, does not effect a cure the diagnosis should be reviewed. Possibly there is associated cystic change in the ovaries and if endocrine treatment fails, laparotomy may be necessary. At or near the menopause treatment by X-rays or radium may require consideration. These methods of treatment are, however, for conditions simulating chronic endometritis. Hysterectomy is indicated only when some additional indication is present such as fibroids or tubal inflammation.

Metritis—Chronic Subinvolution

Diffuse inflammation of the muscular wall of the uterus is caused by the same factors as operate in pelvic infection in general. *Puerperal* and *gonococcal* infection probably embrace the majority of cases. Of these two factors, puerperal infection is by far the more important as gonorrhœal infection is confined almost entirely to the endometrium.

Postoperative infection and degenerating *tumours*—e.g. cancer and fibroids—and the rare cases of spread from an *appendix* or other part of the bowel, or from an ovarian tumour, which has been infected from the bowel after torsion, account for a proportion. *Pyæmic*

30 to 40 mg. distributed in the length of the uterine cavity, and the dosage 2000 to 2400 mg.-hours. Alternatively deep X-ray therapy may be employed. Owing to restriction of the use of radium during the war, X-ray treatment has been more extensively used, and the results have proved very satisfactory. Curettage is previously carried out, in all cases fit for this procedure, to confirm the diagnosis and mainly to exclude malignancy.

Radiation treatment may be unsuitable if there is an additional lesion of an inflammatory nature such as salpingo-oöphoritis or if the uterus is grossly enlarged. In the absence of disease of the appendages or other lesion, hysterectomy by the vaginal route should be employed. If the abdominal route is necessary, then total hysterectomy is the operation of choice, as the cervix is almost always unhealthy.

CHAPTER XLVIII

DISEASES OF THE UTERUS (*continued*)

NEW GROWTHS

NEW growths of the uterus may be either simple or malignant. They are derived from any of the tissue elements of which the uterus is constructed—namely, epithelium, fibrous tissue and muscle.

The following may be encountered :—

Simple—

- I. Polypi of various kinds.
- II. Fibromyoma.
- III. Adenomyoma.

Malignant—

- I. Carcinoma.
- II. Sarcoma.
- III. Chorionepithelioma.

BENIGN TUMOURS OF THE UTERUS

I. POLYPI OF VARIOUS KINDS

The following types of polypi may develop in the uterus :—

- (1) Mucous or adenomatous.
- (2) Nabothian.
- (3) Fibroid.
- (4) Placental.
- (5) Malignant.

(1) **Mucous Polypus.**—These may be found growing either from the mucous membrane of the body or the mucous membrane of the cervix. Sometimes they are found springing from both sites in the same patient.

The ætiology in the majority of cases is obscure. Sometimes there is evidence of a preceding infection. On a preceding page (p. 921) it has been stated that localised polypoidal projections of mucosa are common accompaniments of so-called "glandular endometritis." It is said also that these polypi may be new growths ("adenomata").

A feature of chronic inflammation is hypertrophy. Any localised hypertrophy in the interior of the uterus will tend to become polypoidal by reason of the activity of the uterine musculature. Even cystic distension of a gland on the surface will result in efforts at expulsion and favour polypus formation. Chronic inflammation of the mucous membrane of the cervical canal is extremely common as is also distension of glands. In the case of the corporeal endometrium chronic

inflammation is much less common—*here endocrine influence is the primary cause of hypertrophy in a very large proportion of cases (vide metropathia hæmorrhagica, p. 788).*

Pathology.—They may be single or multiple. They commonly consist of finger-like or globular swellings, which rarely grow larger than a cherry, attached to the lining membrane of the uterus by a narrow stalk. The surface is red and glistening, as a rule. There is a tendency for the stalk to become lengthened, when the little rounded growth may come to project through the external os into the vagina : sometimes they reach the vulvar orifice. In such cases the stretching of

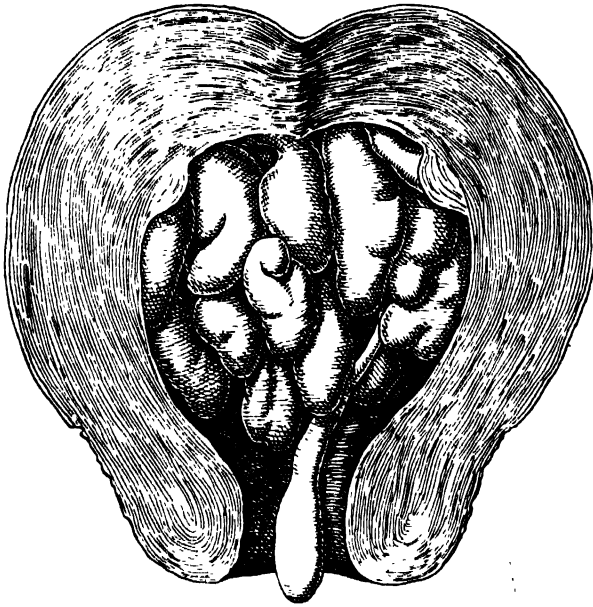


FIG. 366.—Polypoidal Overgrowth of Endometrium— Mucous Polypi.

the stalk leads to an obstruction of the vessels and the polypus becomes congested ; later ulceration of its surface or necrosis may result.

Mucous polypi are not infrequently removed during curettage. They are recognised by their more or less rounded contour and by the fact that they have a complete epithelial covering, as contrasted with the ragged fragments of mucosa which accompany them.

Microscopically the mass of the polypus is seen to consist of the same elements as the mucosa, corporeal or cervical, from which it is derived. The blood-vessels are expanded, and there is usually a marked increase in the number of glands, the tubules of which are often dilated (Fig. 366). The stroma of a cervical polypus is more densely fibrous than that of a corporeal polypus, but sometimes the stroma of the latter becomes more dense and the term “ fibro-adenomatous polypus ” has been used to designate this type—a term which has

also been applied to the fibroid (fibromyoma) polypus in which gland tubules have invaded the fibroid.

Sometimes the surface epithelium of a mucous or fibroid polypus projecting through the external os undergoes transition to stratified squamous epithelium over an area of variable extent or over isolated patches.

Symptoms.—The chief symptoms are (1) hæmorrhage and (2) leucorrhœa. Hæmorrhage is in small amount, irregular and is stimulated by trauma of intercourse, constipated bowel movement, or such as results from vaginal examination.

Signs.—Where the polypi project through the external os as soft, rounded, cherry-like growths the diagnosis is easy. A small mucous polypus can readily be missed if digital examination alone is carried



FIG. 367.—Mucous Polypi—Corporeal.

out. It is soft, slippery, from its covering of mucus, and recedes before the examining finger. This is particularly so during pregnancy. The mistake cannot arise if the cervix is inspected through a speculum. Its bright red colour attracts attention. If not projecting into the vagina, the condition is revealed only by examination of the scrapings of the mucosa removed by the curette.

Treatment.—After the patient has been placed in the lithotomy position and a posterior speculum has been inserted, the polypus, if projecting from the cervix, is grasped with forceps and is easily twisted off. It is well to curette the uterus at the same time to exclude the presence of other polypi, and in view of the fact that there may be an accompanying general proliferative condition of the endometrium. At or after the age of the menopause this procedure should never be omitted as there is the possibility of the presence of adenocarcinoma of the body of the uterus. This malignant condition may be limited to the base of the polypus which elsewhere has a histologically simple structure, a very important point to bear in mind.

(2) **Nabothian Polypus.**—This is a Nabothian cyst of the cervix, which has been extruded from its bed and dangles from the cervical canal or vaginal cervix by a narrow pedicle. They may be single or multiple, and their origin is chronic cervicitis of which Nabothian cysts are an evidence. Of themselves these little polypi cause no symptoms. Their treatment has been dealt with under Cervical Catarrh (p. 914).

(3) **Fibroid Polypus** will be fully discussed in the section dealing with fibromyoma. It consists of a submucous fibromyoma, which has become polypoidal. The majority are of corporeal origin.



FIG. 368.—Placental Polypi.

(4) **Placental Polypus.**—In the puerperium, if a piece of placenta, or chorionic membrane in the case of an early abortion, has remained adherent to the uterine wall, a large swelling may develop by the deposit of blood in increasing laminæ over the surface of the fragment. The solid thrombus thus formed may distend the uterus and its lower end project through the cervix. The chief symptom is profuse and, probably, offensive lochial discharge, with possibly a swinging temperature, which subsides after the mass is removed.

Sometimes a piece of placenta may remain in the uterus, adherent to the wall, for many weeks or months, and the coagulated blood round it may give rise to a distinct polypoidal swelling (Fig. 368). The symptom in such cases is hæmorrhage (menorrhagia and metrorrhagia) which persists until the uterus is curetted. There is sometime a long interval during which there is not any hæmorrhagic discharge, the lochial discharges clearing up normally. This is exceptional, but when it does occur it is misleading.

(5) **Malignant Polypus.**—In some cases a mucous polypus may become malignant, the connective-tissue stroma becoming sarcomatous or the epithelium becoming carcinomatous. These changes are rarely present, though it is notorious how frequently the pathologist finds difficulty in pronouncing whether the tissue changes found in such cases are due to chronic hypertrophy or malignancy. When a mucous polypus shows evidence of malignant degeneration, it is usual for the carcinomatous change to manifest itself first at its proximal end (p. 929).

Malignant degeneration may likewise occur in submucous fibroid polypi. The majority of malignant polypi, however, occur as localised overgrowths, carcinomatous or sarcomatous, projecting into the cavity of the uterus or vagina. They will therefore receive attention in the chapter devoted to the discussion of these subjects.

II. FIBROMYOMA

Fibromyomata, or as they are so frequently designated, "fibroids" or "fibroid tumours," are by far the commonest type of tumour found in the uterus. Indeed, statistics of routine post-mortem examinations demonstrate that this type of tumour is the commonest of all tumours in the female.

Ætiology.—Like other neoplasms, the reason for their occurrence is unknown. Age plays an important part. They are found between the years of thirty and fifty. In a large series of cases treated in hospital the average age was forty-two years (Royal Samaritan Hospital, Glasgow, Annual Reports). It should be remembered, however, that this represents the age of onset of symptoms, not the age at which these growths commence. When we recognise that fibroids may be present in a uterus throughout life and give rise to no symptoms—this is clear from post-mortem records—it is obvious that they must start their growth at a much earlier age. It is believed by some that they are more prone to develop in a uterus deprived of the opportunity of pregnancy. The common *association of sterility with fibroids* is probably, however, explained by the fact that in a proportion of cases the presence of the tumour or tumours prevents conception. If we accept that they usually arise early in the reproductive phase of life, the latter view is likely to be correct.

Morphology (Figs. 369 to 371).—Fibromyomata consist of solid tumours composed of a mixture of fibrous and muscular tissues. Typically they are spherical and they can be shelled out of the muscular wall of the uterus in which they grow.

The relative proportions of muscle and fibrous tissue vary in different cases. Whilst both elements are always present, the one may predominate in one case, the other element in another. A disproportionate amount of muscle tissue results in the formation of a relatively soft tumour (*myoma*), which is likely to be found in younger patients. Fibrous growths (*fibromata*), more likely to be encountered in elderly patients, are densely hard in consistence.

Fibromyomata commence as small seed-like structures in the muscle layer of the uterine wall. *Early, they are composed of smooth muscle fibres with a minimum of binding white fibrous tissue cells.* As they grow the proportion of fibrous tissue increases until in the oldest tumours their composition is almost solely white fibrous tissue. The proportion of muscle to fibrous tissue in any tumour, in the absence of degenerative changes, determines its consistence. The more fibrous tissue present the more solid the tumour is. Apart from this, a fibromyoma in the wall of the body of the uterus practically always is of greater hardness than the wall of the uterus itself. Tumours of small size are not, unless a pregnancy is superimposed, liable to degenerative changes.

Rate of growth varies greatly. Some are encountered as large tumours at an early age. Others attain only small size and are encountered casually—e.g. at an examination on account of some complaint unconnected with the fibroid or at post-mortem examination. Many, however, remain stationary for a long period then, for no apparent reason, start growing. *This development is specially prone to occur in the decade preceding the menopause.* When rapid growth occurs and a tumour attains large size, it rises out of the pelvis and is closely applied to the anterior abdominal wall, like the gravid uterus. Usually, when the abdomen is examined, the firm consistence of the

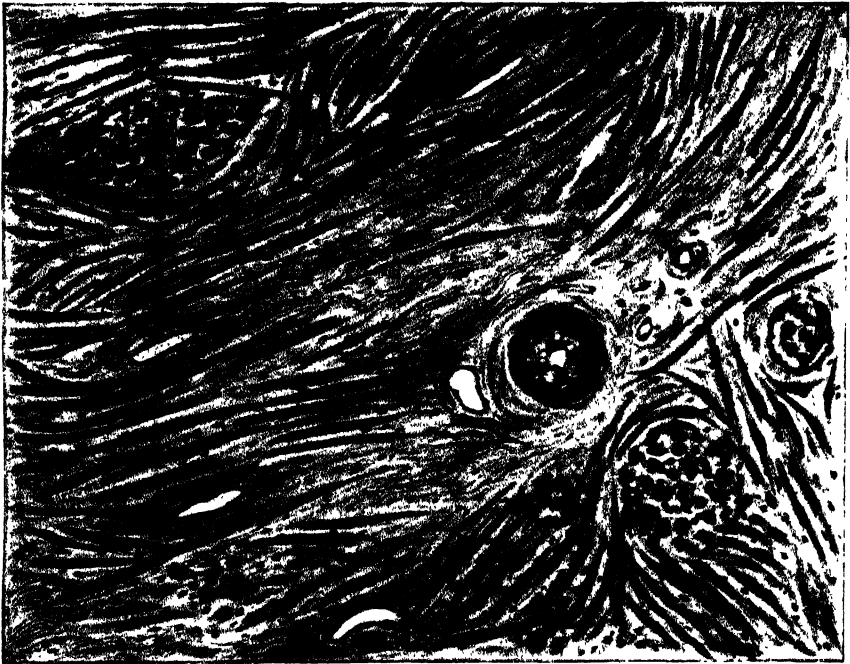


FIG. 369.—Microscopic Structure of Fibromyoma.

swelling makes for easy recognition. Besides, the fibromyoma is generally multiple, so that the swelling produced is asymmetrical in addition to being hard.

When bisected with a knife the tumour is noticed to be abruptly marked off from the surrounding muscular wall of the uterus, the adjacent layers of which are arranged round it to form a capsule. That it is under tension in its capsule is proved by the fact that in a fresh specimen the cut surfaces become convex. The tumour is paler than the normal muscle because of the greater amount of fibrous tissue present and the relatively poorer blood supply which it possesses. The cut surface has a watered-silk appearance due to the bundles of fibres being cut at different angles. Even on naked-eye examination of the

cut surface, a distinction between the two elements of which the tumour is composed may be detected. The paler connective tissue surrounds the bundles of muscle, and the isolated masses thus formed become closely packed together and give rise to an appearance which has been likened to balls of cotton-wool closely pressed together (Fig. 369).

The most vascular area of the growth is at its periphery. Progressive development is apt to leave the central regions with an impoverished blood supply, a fact of considerable moment in explaining the degenerations to which this class of tumour is prone.

Sometimes a development of distended veins occurs on the periphery

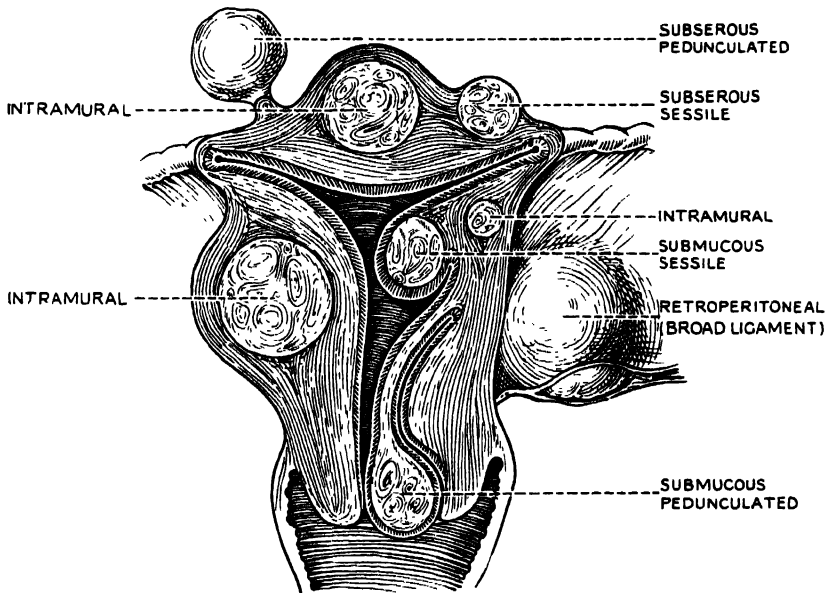


FIG. 370.—Fibromyomata of Corpus Uteri illustrating Classification in Text.

of a fibroid, and where this possesses nothing but a peritoneal investment, as is the case in the subserous type, rupture of a vein may, on rare occasions, cause severe intra-abdominal bleeding.

Classification.—Fibroids may develop in either or both, body and cervix uteri: the former site is the commoner. According to the position which they occupy they are divided into four classes: (1) Interstitial or Intramural; (2) Subperitoneal or Subserous; (3) Submucous; (4) Retroperitoneal (Fig. 370).

An analysis (ten years) of cases at the Royal Samaritan Hospital, Glasgow, demonstrates the relative frequency according to situation, thus: total cases, 1,385; body, 1,319; cervix, 66. Of the body cases 719 were examples of multiple tumours and in 600 the tumour was single. Of the solitary tumours in the corpus uteri their situation was as follows: 173 subserous, 286 interstitial, 127 submucous and

13 retroperitoneal (intraligamentary). Practically all cases of cervical fibroids are single tumours and a very considerable proportion are of the retroperitoneal or burrowing type.

While it might appear from these figures that the incidence of cervical fibroids was not more than 5 per cent., it must be remembered that in a small proportion of cases of multiple fibroids grouped as corporeal, a tumour might be located in the cervix. This is a comparatively rare occurrence as cervical fibroids are almost always single—7 per cent. would be a generous estimate of the incidence of fibromyoma of the cervix. It does very occasionally happen that a fibroid develops in the stump of a cervix remaining after subtotal hysterectomy, usually, but not always, when the operation was performed for fibroids of the body of the uterus. The infrequency of this experience demonstrates the rarity of cervical origin for this tumour.

The interstitial site (the original position of these growths judging from single tumours of the body) is, from the foregoing figures, retained as the commonest site at the time of operation.

CORPOREAL FIBROMYOMATA—(1) *Interstitial (Intramural) Fibromyomata* (Figs. 370, 372).—All fibroids commence as interstitial growths and for a considerable time, and even up to a large size, they may remain completely surrounded by a layer of muscle. After a time, however, the enlarging tumour displaces the uterine wall and comes to project under the peritoneum. It is then referred to as being subserous or subperitoneal. Alternatively it may push its way towards the cavity of the uterus until it is directly invested by the mucosa over a part of its surface, and is then referred to as submucous in type.

(2) *Subserous (Subperitoneal) Fibromyomata* (Figs. 372, 373).—Fibroids bulging on the peritoneal surface of the uterus cause an irregular bossing and, when multiple, the different-sized growths may cause great distortion of the uterus with complete loss of its normal smooth contour.

To begin with subperitoneal nodules are *sessile*, and this condition they may retain throughout.

In many instances the gradual pressure exerted by the muscular wall of the uterus may force the tumours farther and farther free of the uterine wall until they become pedunculated. If attached only by a thin stalk they naturally suffer from an impoverishment of blood supply. This class of tumour is therefore specially liable to undergo degenerative changes. Another factor which may arise in stalked tumours and cause vascular interference is *torsion of the pedicle* (*vide* p. 939). In some few instances complete detachment of the tumour may occur, and to such tumours the term *parasitic or wandering fibroids* is sometimes given. Such tumours obtain their blood supply from the surrounding tissues to which they have become adherent or into which they have become embedded.

(3) *Submucous Fibromyomata* (Fig. 370).—These may be *sessile* or

polypoidal. As in the case of subserous tumours, submucous growths may be single or multiple. In some cases the lining membrane of the uterus may be studded with as many as fifty or more discrete nodules, mostly sessile and probably faceted. This is unusual. More commonly there are one, two, three or four tumours. The muscular contraction of the uterus tends to drive a sessile nodule more and more into the cavity until it is attached merely by a stalk; in this way the tumour becomes polypoidal. By virtue of the continued expulsive activity of the uterus such polypoidal tumours may be driven farther and farther down and may eventually open out the cervix, bulge into the vaginal vault or even become completely delivered from the uterus, the cervix closing down on the stretched stalk. Occasionally the pedicle is severed and spontaneous cure results following expulsion of the tumour from the vagina.

The same tendency to interference with the blood supply, which we have noted as characterising the pedunculated subserous growths, is found accompanying such submucous polypoidal fibromyomata. Degenerative changes are therefore common, and *infection* occurring readily when the tumour is exposed in the vagina, septic changes are frequent. These precipitate a rapidly occurring necrosis with softening and breaking down of the tumour and produce a copious foul discharge from the vagina.

A rare complication associated with submucous fibromyomata is *inversion* of the uterus (p. 862). As the growth is driven downwards in response to the expulsive action of the womb, it may drag with it a knuckle of uterine wall at the point to which the pedicle is attached. Complete inversion of the uterus occurs but is surprisingly rare.

(4) *Retroperitoneal Fibromyomata*.—This type projects from the surface of the uterus where it is uncovered by peritoneum such as the lateral wall. It is a type more common in the supravaginal cervix which has no peritoneal layer in front or at the sides (Fig. 371). Tumours developing along the lateral wall of the body of the uterus often burrow as sessile growths between the layers of the broad ligament (broad ligament or intraligamentary fibroids). If they grow to any size they tend to strip the peritoneum upwards from the pelvic walls and establish retroperitoneal relationships. Burrowing behind, they may drag the peritoneum off the pelvic colon and expanding upwards above the pelvic brim they may even burrow between and split apart the layers of the mesentery of the sigmoid, the ascending or descending colon, or even of the small bowel. Such retroperitoneal fibroids often present great surgical difficulties in their removal.

CERVICAL FIBROMYOMATA.—The cervix is, as has been pointed out, a rarer site than the body for the development of this tumour. From the severity of the symptoms which they tend to cause and from the difficulty often encountered during their removal, they constitute, on the whole, a more dangerous class of growth. Cervical fibro-

myomata, because of their position, have a special tendency to become retroperitoneal.

Unlike those growing in the body, which naturally tend to ride free in the pelvis, and later in the abdomen, cervical tumours, because of their site, remain fixed in the pelvis. Restrained by the attachments of the cervix, they tend to grow circumferentially until, in the case of the larger growths, they press outwards against the pelvic walls. At the same time the lower pole projects farther and farther downwards towards the pelvic floor, whilst the upper surface rises and may project into the abdomen. In one instance incarceration in the pelvis was so pronounced as to result in some of the markings of the bones of the

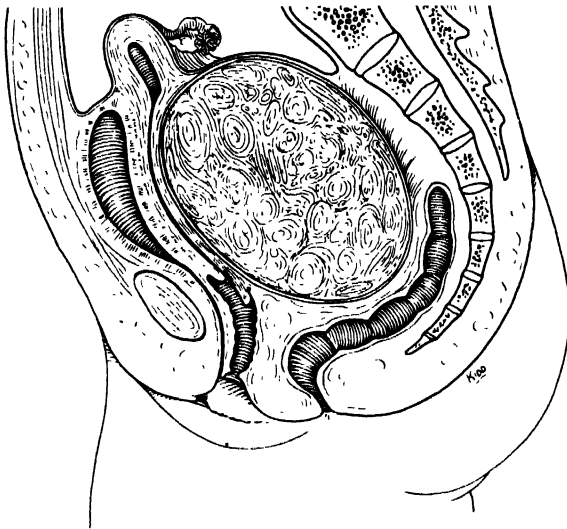


FIG. 371.—Interstitial Fibroid of Cervix Posterior Wall.

pelvis being apparent on the surface of the tumour after removal (M'Intyre).

An obvious result of these circumstances of growth, which distinguish a cervical tumour from its fellow originating in the body of the uterus, is that pressure effects on bladder, urethra, ureter, and rectum are more common. Another character which distinguishes a cervical growth is that during its expansion it tends to lift the uterine body with the attached broad ligaments and uterine appendages upwards into the abdominal cavity so that the uterine body appears perched on top of the tumour (Fig. 371).

Fibromyomata of the cervix can be divided into the same four types as in the case of the body of the uterus. The *interstitial* fibroid causes a broadening of the cervix. The cervix and its canal is elongated and stretched over the surface of the growth (Fig. 371). A sessile submucous fibroid produces the same result. The *subserous*

type, from the posterior wall of the supravaginal cervix, has more freedom of expansion and will strip the peritoneum from the posterior wall of the pelvis upwards off the bowel, and may even reach a height to separate the layers of the mesosigmoid. The *retroperitoneal* variety is noted for its burrowing propensity. Arising low in the lateral wall of the cervix it tends to burrow deeply into the cellular tissue of the pelvis and will eventually produce symptoms due to pressure. Anteriorly a tumour may extend below the bladder and raise it up into the abdominal cavity. The *submucous* fibroid may be sessile or pedunculated. The sessile type tends to be extruded through the external os which is often stretched open over its surface. The pedunculated tumour lies in the dilated cervical canal or projects into the vagina.

Fibromyomata of the *vaginal portion of the cervix* are relatively rare. While a pedunculated tumour projecting into the vagina may have the attachment of its pedicle within the cervical canal, more often the pedicle can be traced into the cavity of the uterine body. Interstitial fibroids of the vaginal portion of the cervix are rare. A pedunculated fibroid attached to the vaginal *surface* of the cervix is practically never encountered.

Changes induced by or accompanying Fibromyomata.—*Ovaries and Tubes.*—A fibromyomatous uterus is frequently associated with cystic change in the follicles of the ovaries. One or both ovaries may be involved, and there may be one or several cysts in the affected organ. This ovarian disturbance may be revealed also through absence or imperfect formation of corpora lutea. It has sometimes been maintained that the aberration of ovarian function connoted by these structural changes may account largely for the hypertrophy of the uterine mucosa and the irregular and excessive bleeding often found with fibroids.

Chronic inflammatory changes in the Fallopian tubes and ovaries are often encountered. Frequently the tubes and ovaries are found adherent to surrounding structures. Occasionally hydrosalpinx, pyosalpinx, or even hæmosalpinx is found.

Blood Supply.—As tumours of large size require a blood supply in excess of that normal to the uterus, hypertrophy of the uterine or ovarian artery or both may be noted on one or both sides. Veins may be numerous, greatly distended and irregularly disposed so that they may give trouble at operation or predispose to post-operative thrombosis. Rupture of a subperitoneal vein with intraperitoneal hæmorrhage has already been mentioned (p. 933).

Cavity of Uterus.—The cavity of the uterus is distended by a submucous or interstitial growth. Apart from expansion of area of endometrium produced by such growths, there is often thickening of the endometrium; indeed, this may even occur with the subserous type. Submucous fibromyomata may cause marked distortion of the

cavity and the tumours if very numerous may be faceted like gall-stones. Hypertrophy of the uterine wall commonly accompanies an interstitial growth and adds to the size of the uterus as found on clinical examination. The hypertrophy of muscle wall and mucosa suggest some abnormal endocrine activity. The increase in muscle tissue may in part be a "work hypertrophy."

Displacements of the uterus are common. Growing in the anterior wall a fibromyoma may displace the uterus backwards; in the posterior wall, forwards, or by its weight it may drag the uterus backwards. The cervical fibroid, according to direction of its growth, may elevate the body of the uterus out of the pelvis and it may press the cervix downwards. Inversion of uterus has been referred to already (p. 935).

Torsion of Uterus.—With multiple fibromyomata which produce an asymmetrical enlargement, depending on the relative rate of growth and situation of the masses, the uterus may be gradually rotated on its own axis. This in slighter degree is a frequent occurrence. When the rotation is more pronounced it usually has taken place so slowly that there is not any vascular disturbance. Rarely the torsion is rapid and accompanied by swelling, congestion and discoloration of the uterus and its tumours. Necrosis or gangrene may supervene.

Torsion of Subperitoneal Pedunculated Fibromyomata.—A growth which is attached by a pedicle is subject to the risk of torsion. The factors operating are similar to those present in axial torsion of ovarian tumours (p. 1022); they seem to be due, in some way or other, to the action of eccentric forces in the abdominal cavity. Torsion of fibromyomata occurs less commonly than with ovarian tumours, and in both may be of gradual or of acute onset. The result in either case is an interference with the blood-vessels which nourish the tumour, the two conditions being distinguished by the rapidity and intensity of the vascular changes.

In *gradual torsion* the twisting of the pedicle occurs as a slow process, and for some time impairment of the blood supply may be delayed by the fact that the vessels are able to accommodate themselves to the altered circumstances by a stretching of their walls even if several twists are present. If the condition progresses, vascular involvement becomes inevitable, and it is the thinner-walled veins which first suffer. A gradually increasing congestion and enlargement of the tumour takes place, with eventually extravasation of blood into its substance.

These changes are followed by adhesions which are laid down on the surface of the tumour and which bind it to surrounding structures—*e.g.* omentum, bowel, etc. (Fig. 372). The gradual nature of the changes allows of vascularisation to take place through the adhesions, and it thus happens that by the time the pedicle has twisted so greatly as to result in its detachment, the tumour has come to be adequately supplied in nourishment by the adventitious blood supply carried to it from the

structures to which it is adherent. A tumour of this kind is said to be *parasitic*.

The symptoms of this variety of torsion may be very slight—they are similar to those present with the more common complication of slow torsion of an ovarian cyst (*q.v.*, p. 1022).

In *acute torsion* the twisting occurs suddenly, leading to immediate impairment of the blood supply. The acute change may supervene



FIG. 372.—Subperitoneal Fibroid with Torsion of Pedicle and Adhesions to Omentum.

on a gradual torsion or it may develop entirely as a new phenomenon. The intensity varies in different cases. With considerable or complete blockage of the veins alone, sudden congestion and enlargement of the growth occur. Where the torsion is so complete as to involve the arteries as well, gangrene takes place.

In this class of case the symptoms are acute; and immediate operation is necessary.

In either class of torsion, though the risk is naturally greater in the acute cases, infection of the tumour is apt to occur from the bowel to which the tumour may have become adherent.

Degeneration of Fibromyomata.—If all fibromyomata removed at operation were examined microscopically a large proportion would show degenerative changes, mostly of a hyaline or cystic character. These changes are most frequent in the interstitial variety and least common in the subserous type. Cervical growths are if anything less liable to secondary changes than are those situated in the body.

Degenerative changes to which fibroids are subject are as follows :—

- | | |
|-----------------|-------------------------------------|
| (1) Atrophic. | (6) Necrobiosis (Red Degeneration). |
| (2) Hyaline. | (7) Necrosis. |
| (3) Cystic. | (8) Inflammatory. |
| (4) Fatty. | (9) Malignant. |
| (5) Calcareous. | |

(1) **ATROPHIC DEGENERATION.**—Atrophy of a fibroid may occur after the menopause as an incident in the retrogressive changes to which the genital organs are subject from this time onwards. Clinically, small tumours may even disappear completely. Similarly shrinkage of a growth may take place after the artificial menopause established by bilateral removal of the ovaries. The therapeutic effects of X-rays and radium on fibromyomata depend partly upon the destructive influence these agents exert on the cells of the growth, but probably to a greater extent on the effect they exert on the ovaries.

(2) **HYALINE DEGENERATION.**—It has already been mentioned that, with the peripheral development of a growth, the blood supply of the central area is apt to become impaired. Thus it arises that changes are common in the interior of a fibroid. These sequelæ of an impoverished blood supply are particularly prone to develop at or after the menopause, when increasing fibrosis tends to make the tumour denser and less vascular. In some cases the changes may involve only small areas of the growth, whereas in others the entire tumour may be affected.

With the naked eye hyaline degeneration is recognised by the presence of areas of irregular outline and of homogeneous appearance, which stand out in relief against the more solid and fibrillated structure of the tumour. In preserved specimens these areas have a very typical "ground glass" appearance.

On *microscopic* examination the earliest change consists of a disappearance of outline of the muscle fibres. The cell-bodies are fused together in a structureless mass (hyalin). The nuclei persist until later, but eventually disappear. The affected areas, which may be gross or only microscopic, remain clear or absorb the colour only slightly in stained sections.

(3) **CYSTIC DEGENERATION** (Fig. 373).—Like hyaline degeneration this is a change of comparatively common occurrence. It is a sequel to liquefaction occurring in the hyaline areas, with the production of scattered cystic spaces containing clear fluid and bounded by ragged walls covered with a soft greyish débris. In other cases the contents

are comprised of a greenish or greenish-yellow viscid material. The amalgamation of smaller cysts may result in the production of large cystic cavities, but always with ragged walls.

Hyaline and cystic changes are commonly encountered in the older tumours removed from women about the age of the menopause. A circumscribed smooth-walled space suggested by the term "cyst" does not apply to cystic degeneration of fibromyomata. In the rare

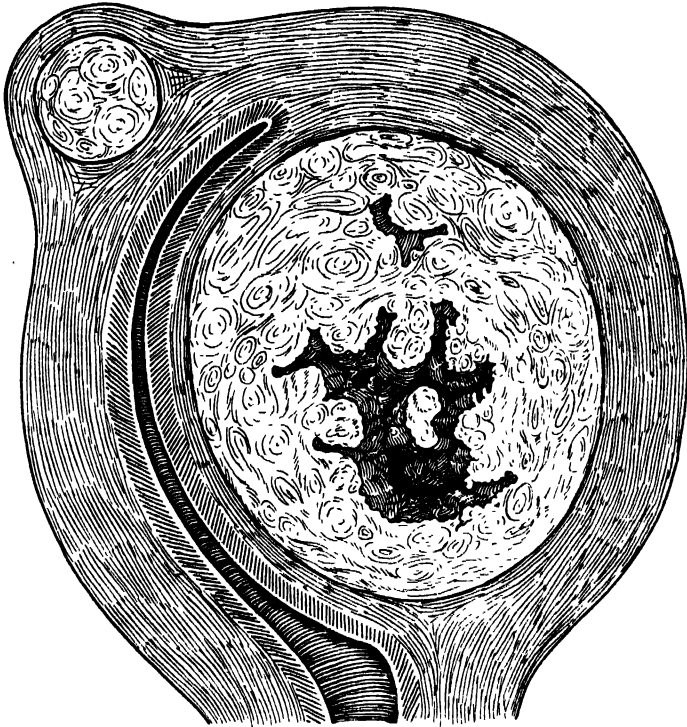


FIG. 373.—Interstitial Fibromyoma showing Cystic Change due to Hyaline Liquefaction, also Intramural Fibromyoma.

instances when these occur the cavities have a regular contour and when examined microscopically are found to have an endothelial lining. Such cavities are believed to be formed from dilated lymphatics.

In other cases the cystic spaces are lined by a cubical or columnar epithelium. This variety of cyst, however, is found only in fibroids which possess adenomatous inclusions—*i.e.* *adenomyomata*, which receive special notice later (p. 953).

In rare cases cysts filled with chocolate-coloured viscid blood are found imbedded in the substance of a fibroid growth. These may be single or multiple and rarely reach any considerable size. In the majority, if not in all, such pent-up areas of extravasation correspond to pockets of mucous membrane derived from the endometrium which have extended into the tumour during its growth and have eventually

been shut off. The blood areas thus correspond to dammed-up menstrual discharge. Tumours exhibiting this change belong also to the class of adenomyoma. We thus have an example of fibromyoma and adenomyoma of the uterus, a combination of two simple tumours in the one organ. This combination is, however, very rare.

(4) FATTY DEGENERATION.—This is a change which, like the other degenerations mentioned already, is more common at and after the menopause. It results from the deposition of fat globules in the cells of the tumour, *not the presence in the tumour of fat cells, for this would be a lipomyoma*—a very rare type of tumour. Special methods of staining are required to recognise the globules in microscopic sections. Naked-eye diagnosis from the cut surface of a tumour is not reliable. This degeneration would require to be very pronounced to be recognisable from the macroscopic appearances. *Fatty degeneration is a necessary precursor of calcareous degeneration.*

(5) CALCAREOUS DEGENERATION.—This type of degeneration is most likely to be found in old tumour masses after the menopause. After deposition of the fat globules, saponification occurs, then, from the carbonic and phosphoric acids in the circulation, calcium carbonate and calcium phosphate are deposited in the growths. As the supply is brought to the periphery of the tumours first it is strikingly noticeable that calcareous deposit commences in this part. In very old tumours the entire mass may be calcified to form the so-called “womb-stone.” Examples of these are much less common than formerly as fibromyomata are now recognised at a much earlier stage and dealt with in a manner suitable for the case. In the course of operating densely calcified fibroids are sometimes still encountered.

(6) NECROBIOSIS (RED DEGENERATION).—The pathology of this change is still not clear. A somewhat unscientific definition would be “a change in the direction of necrosis but the tissues retain the power of recovery.” Tissues beyond the stage of recovery are *necrotic*. This degeneration is due to some deficiency in the blood circulation in the tumour. It is in the mechanism producing this that our knowledge is deficient. *It is particularly apt to affect a fibroid in a pregnant uterus.* It may be found in a tumour in which the pedicle has become twisted. Although necrosis is more likely if the blood supply is completely cut off.

Necrobiosis, unlike most other degenerative changes (necrosis excepted) may be very dramatic in its behaviour. There is sudden severe pain, pyrexia, rapid pulse and sometimes violent vomiting, and this may occur when part only of a small tumour is affected.

On bisecting a tumour which has undergone necrobiosis, all or part (especially the central part) may show the characteristic changes. The cut surface affected has the appearance of raw beef steak, rather dark, and has a fishy odour. The tumour is more flaccid and does not bulge out of its capsule to the same extent as the unaltered fibroid. The

colouring of the affected area is due to blood pigment in solution in the products of autolysis of the degenerating tissues of the growth. Whatever the explanation of this change may be, the colour and generous supply of blood and blood pigment points to a congestive phase preceding the change. That is to say that the circulatory difficulty appears to be one of obstruction to the outflow from the tumour rather than a starvation of blood to the tumour. This degeneration as already noted, is common during pregnancy when the blood supply to the uterine wall is most generous (p. 294). When symptoms are very pronounced only a small area in the centre of a growth may show the characteristic changes.

(7) NECROSIS may affect the entire tumour or only a part, most often the centre. Torsion of a fibroid rarely occurs to the extent of sudden complete obstruction of circulation. Necrosis in a tumour may be preceded by hyaline degeneration which may be looked upon as a form of cell necrosis. When massive necrosis occurs suddenly, the clinical picture is similar to that described for necrobiosis. This degeneration may follow labour, as a result of injury to the tumour by pressure (p. 549).

(8) INFECTION of a fibroid occurs under two conditions. A submucous tumour, especially if polypoidal, may undergo necrosis as the result of impoverished nourishment, and when this occurs, the degenerating surface which is exposed in cervix or vagina forms a ready soil for the growth of infective germs. Sometimes infection of a submucous tumour occurs after it has been damaged as the result of injudicious curettage carried out with the intention of controlling hæmorrhage. In other cases the infection follows labour, during which a fibroid present in the womb has been damaged. Infection of an exposed tumour is associated with swelling and softening of the growth and with the escape of a foetid discharge from the vagina. A secondary infection of the tubes and ovaries may occur. *Salpingitis* and *pyosalpinx* may result without gross evidence of infection of the fibroid. Such tubal infection may constitute a grave complication.

The second condition which predisposes to infection of a fibroid is axial torsion. When this occurs the subperitoneal growth is liable to become adherent to bowel, from which infection may be transmitted. The symptoms induced by infection are swelling and softening and tenderness of the growth, pyrexia and very often sickness and vomiting.

In deep-seated and better protected growths infection by the blood-stream is a possibility, but is very rare.

(9) MALIGNANT DEGENERATION.—Fibroids may exhibit malignant changes. Being mesoblastic in origin, the type of primary malignancy which they show is *sarcoma*. Sarcoma occurs in about 1 per cent. of cases. It is characterised by the occurrence of soft areas in the substance of the growth and by a rapid increase in its size. To the naked eye the malignant patches resemble areas of hyaline degeneration, but

their nature can be decided definitely only by microscopic examination. Metastases may occur in such cases. The microscopic appearances presented in the case of this class of malignancy are those of a spindle-celled sarcoma. The rarer subtypes of sarcoma—viz., *perithelioma* and *endothelioma*—are occasionally found. In some instances, it should be remembered, a sarcomatous infiltration of a fibroid may occur as a secondary spread from a sarcoma growing in the endometrium (p. 982).

In most instances a sarcomatous change arises from a metaplasia of connective-tissue cells. In rare instances the malignant change affects the muscle elements, and to this class of tumour, which may arise in the uterus independently of fibromyoma, the terms *malignant myoma* or *leiomyoma* are given. Here the malignant cells propagate as differentiated muscle, and as such they may form metastases in pelvis, lungs, liver, etc.

Carcinoma may likewise extend secondarily into a fibroid by direct spread from a cancerous endometrium. It is believed that a uterus which is the seat of fibroid growth is more prone to the development of carcinoma than is the healthy uterus. The proportion of fibromyomatous uteri which become carcinomatous has been given as from 3 to 4 per cent. If one takes all cases of adenocarcinoma of the body of the uterus removed by hysterectomy, fibromyomata are found in 8·7 per cent (p. 979) (McIntyre).

Clinical Features.—*Age Incidence.*—The age of election for fibroids is the decade between thirty-five and forty-five. Occasionally fibroids are found in women at a younger period, but only comparatively rarely do they cause symptoms under the age of thirty. In a large series (McIntyre) the average age at which operation was performed was forty-two years. They have never been described before puberty. At the other extreme of life they are believed never to originate after the menopause. Nevertheless, the first indication of their presence may occur well after the menopause; but generally only if some of the degenerations mentioned have developed.

A large number of fibromyomata cause no symptoms and are only discovered accidentally during examination, or during laparotomy for some other condition.

Menstrual Symptoms.—These constitute the first symptoms in the majority of cases of fibroids. In a typical case suspicion is first aroused when, in a woman between thirty and forty-five, the menstrual flow becomes increased in amount. This *menorrhagia*, once established, tends to become more pronounced month by month, until eventually the blood loss may be very excessive. As time goes on the intermenstrual period becomes encroached upon, until the patient, whose normal menstrual duration is four days, has a blood loss every month extending over six or eight days or even longer. Eventually there may be little interval between successive periods, and irregular hæmorrhages may occur during these intervals—*metrorrhagia* (*vide* p. 784).

Excessive hæmorrhage is by no means a constant symptom in fibroids. It is only present to any appreciable degree in submucous growths, and is usually absent when the tumours are wholly subperitoneal. The excessive loss which characterises a submucous tumour is due to a combination of factors—the increased surface of endometrium which invests the tumour and the uterine cavity expanded by the tumour, the associated congestion which is present, and the common association of degenerative changes with the production of an exposed ulcerating surface. We have already seen that cystic changes in the ovaries are common with uterine fibroids and that many observers attribute the excessive uterine bleeding to ovarian dysfunction.

An incidental result of a fibroid, especially if submucous in position, is a *delay in the onset of the menopause*; in some cases menstruation may persist until the patient is fifty-five or even older.

Dysmenorrhœa is an occasional symptom in fibroids, especially in the interstitial variety when a degenerative change is present (p. 803).

Vaginal Discharge.—This is a symptom commonly present with submucous growths. When degenerating, and especially when septic, the vaginal discharge may be copious and foul, and is usually, at the same time, blood-stained. There is only one other condition—namely, cancer of the cervix—which causes this symptom in the same degree (p. 967).

Pain is not a common symptom in fibroids, and in this respect fibromyomata differ markedly from ovarian tumours in which pain is comparatively frequent. This symptom occurring in fibroids denotes degeneration in the tumour itself, an associated pyosalpinx, or pressure on surrounding structures. Pain due to pressure is specially apt to develop in fibroids whose growth is limited to the pelvis. From what has already been said, it will be evident that *pressure symptoms* are specially liable to be associated with cervical fibroids.

Fibromyomata growing from the body, unlike cervical fibroids, are free to expand into the abdomen, where they may attain considerable proportions before their presence is detected. Large tumours in the abdomen may cause discomfort and pain. In the case of a smaller growth in the body of the uterus riding free in the abdomen these symptoms usually denote some secondary change.

Spasmodic pain may occur during the passage of a pedunculated submucous fibroid through the cervical canal.

Dyspareunia may be present in the case of polypoidal fibroids projecting into the vagina. Fibroids incarcerated in the pelvis, mostly of cervical origin, may compress the vagina, alter its axis and cause distortion so that coitus is impossible or is attended with extreme discomfort.

Sterility.—Fibromyomata constitute one of the common causes of loss of fertility in women over thirty (p. 820).

On the other hand, pregnancy frequently occurs, and if the

presence of the growth does not embarrass the circulation in the placenta, nor mechanically interfere with the development of the child, and if the tumour does not seriously interfere with normal functions or undergo degeneration the pregnancy may continue till full term without incident. Should, however, the presence of the growth cause the death of the ovum or foetus, this may in turn lead indirectly to degenerative changes in the tumour. These risks are referred to later in this chapter under the heading of "Fibromyomata complicating Pregnancy."

Bladder Symptoms.—The pressure of the growth may cause irritability and frequency, and a fibroid located in the pelvis may cause difficulty in micturition, and, in an aggravated case, retention of urine. As a cervical fibroid expands it pushes the bladder upwards and forwards above the pelvic brim. This in its turn results in stretching of the urethra, which it displaces to one or other side or presses it against the pubis. Thus is explained the retention of urine which is occasionally encountered and at the same time the difficulty often met with in attempts to pass a catheter. One may fail to insert a metal or glass catheter, but a rubber catheter may be successfully introduced. In growths projecting from the anterior wall of the supravaginal cervix, as the bladder is raised on the face of the tumour, the upward traction exerted on the urethra tends to pull the urethral opening within the vaginal orifice. Unless this fact is remembered, vain efforts may be made to find the meatus at the vulva. In such cases the displaced urethral orifice is readily discovered just within the vagina. This is clearly shown in Fig. 371, although in this case the tumour is posterior.

Bladder symptoms caused by the pressure of a pelvic growth may develop insidiously or, on the other hand, they may develop suddenly in a patient who has previously had no urinary trouble. An interesting phenomenon, and one which is so characteristic as to be pathognomonic, is *retention occurring suddenly just before or at the commencement of menstruation*. The rationale of this occurrence is that congestion incidental to the menstrual process causes additional enlargement to a tumour which is already on the verge of causing obstruction. The menstrual congestion is the last straw and suddenly precipitates a sudden retention of urine.

As we have already noted, the bladder is lifted up in such cases so that it lies directly against the anterior abdominal wall, where it may, unless care is taken, be injured when laparotomy is performed (p. 1068). When the bladder is much distended, it forms an ovoid swelling visible in the lower abdomen. It will be apparent from what has been said that great care must be taken to ensure complete emptying of the bladder before an abdominal operation for fibromyomata.

Before leaving the urinary system a word or two is necessary regarding the *ureters*. With a retroperitoneal tumour of the cervix,

especially one directed to the side, pressure on a ureter may result in distension of ureter and pelvis of the kidney. In the removal of such a tumour the ureter is liable to injury as it is found coursing over the surface of the growth. When separated, almost always it is found to be thicker than normal. It is surprising that complete obstruction of a ureter does not sometimes occur. It is rare to find infection of the kidney pelvis which can be definitely attributed to constriction of the ureter.

Rectal symptoms due to pressure sometimes are present in the case of fibroids growing in the pelvis, and fibroids in the abdominal cavity may cause symptoms from interference with the function of upper levels of the intestinal tract. The mechanical effects on peristalsis would appear to produce digestive disturbances, referred to by the patient as "indigestion." In many cases, sickness and bouts of vomiting have disappeared after operation for fibroids. Obstruction causing constipation is especially liable to occur in the case of a growth blocking the pelvis, and we have seen a case of persistent diarrhoea with marked inanition caused by a fibroid and cured after its removal. On the other hand, a large tumour, which rides free in the abdomen, may be uncomplicated by any such symptoms. It may be said that with fibroids in the pelvis urinary disturbance is more likely than disturbance of bowel function, and the former will almost certainly precede the latter if it occurs.

Symptoms due to Pressure on Nerves.—Sensory phenomena, such as pain, caused by the direct pressure of a fibroid growth on the nerve trunks are uncommon, though in some cases a growth incarcerated in the pelvis may cause severe pain in the back and sacrum radiating down the legs. It is believed that even genuine sciatica may be caused.

General Symptoms.—Increasing size of the abdomen is often the first symptom in fibromyoma. In many cases, however, this symptom does not specially attract the suspicion of the patient, who is apt to imagine that it merely implies increasing obesity, especially if she is at the age of the menopause.

Anæmia is common, particularly in the case of submucous fibroids which, irrespective of their size, are so prone to produce bleeding. In some cases pallor is extreme, and at first glance the patient's condition may rouse in the doctor's mind a suspicion of pernicious anæmia. Probably the anæmia so often present explains the *cardiac symptoms* sometimes associated with fibromyomata. There may be *chronic ill-health* even where bleeding, pressure symptoms, etc., are absent, and it is noticeable how frequently in such patients removal of the growth is followed by an improvement in general health.

Dyspepsia, neurasthenia and the other symptoms which are apt to follow in the train of any chronic ailment may be present.

Physical Signs of Fibromyomata.—There may be no signs by which the presence of a fibroid can be recognised either on abdominal

or bimanual examination. Such may be the case with a small sub-mucous growth, not large enough to cause any detectable increase in size of the uterus.

The most characteristic sign of fibromyoma is the discovery of a solid growth or growths incorporated with or projecting from the uterus. In most cases the tumours are situated within the uterine wall and, as they enlarge, they increase the size and, at the same time, cause a distortion in the shape of the womb. In the case of small tumours, the enlarged uterus beset by the firm nodules and confined to the pelvis can be recognised only by bimanual vaginal examination.

Larger growths are felt on abdominal examination, and are usually easily recognised by their hardness and by the irregular, lobulated contour of the swelling. Their incorporation with the uterus is, in the ordinary case, easily recognised by the bimanual method of examination, when the uterus is felt to expand into the growths.

There are two conditions which modify the description of the type of growth which has just been given, and which sometimes render the diagnosis more difficult.

In the first place a subperitoneal tumour, which is attached to the uterus by a stalk, may appear to be independent of the womb and may simulate an ovarian or a tubal swelling. In such cases, however, care in examination usually brings out its attachment to the uterus, and its real nature is further confirmed if there happen to be other solid growths imbedded in the uterine wall.

In the second place it not infrequently happens that the growth causes a regular, uniform expansion of the uterus, with none of the irregular bossing so characteristic of fibromyomata. In these instances the uterine enlargement may be difficult to distinguish from pregnancy (p. 949). Even after laparotomy the surgeon may require to incise the mass before he is satisfied that his diagnosis is correct.

On auscultation a *blowing souffle* can often be heard over the surface or at the sides of a fibroid growth, similar in nature to that present in pregnancy (*vide* p. 172). This sign is dependent upon the fact that the stethoscope has been placed upon a distended vessel and the blood is then audible as it flows through the temporarily narrowed blood channel.

Tenderness on pressure is a comparatively uncommon physical sign. It should always be considered as denoting the probable existence of degeneration. Another sign which commonly accompanies the tenderness in such cases is a rapid increase in size of the tumour.

Diagnosis of Fibromyomata.—The two conditions which demand special care in this connection are ovarian tumour and pregnancy.

Distinction between Fibromyoma and Ovarian Tumour.—The rate of growth of a fibroid is usually very slow, whereas that of an ovarian tumour is usually more rapid. The uterine growth is densely hard, whilst an ovarian tumour is in a large proportion of cases cystic,

and a thrill can be transmitted through the contained fluid, This latter sign is rarely obtained in the case of fibromyoma, and only if it has undergone marked cystic degeneration. In the case of a fibroid, hæmorrhage is a common symptom ; this symptom is rare in the case of an ovarian tumour. Finally, bimanual examination usually reveals beyond doubt the uterine origin of the growth in the case of a fibroid, though a pedunculated tumour may closely simulate an ovarian neoplasm. The recognition of normal ovaries apart from the tumour settles the diagnosis, but they are often not palpable.

Distinction between Fibromyoma and Pregnancy.—The consistence of a fibromyoma and that of the gravid uterus is ordinarily quite different. One is hard, the other is soft. Difficulty arises when degenerative changes in a fibromyoma render it soft, possibly as soft and cystic as the gravid uterine body. The gravid uterine body examined during a contraction, especially with a firm, tense abdominal wall, may feel as solid as the average fibromyoma. The symptoms are usually sufficient to prevent any ambiguity. The amenorrhœa, morning sickness, breast tenderness and enlargement, etc., indicate pregnancy. The consistence and intermittent hardening and softening of the abdominal swelling, with, in addition, if the pregnancy is sufficiently far advanced, the recognition of the foetal heart, ballottement, and the foetal parts clinch the diagnosis. Sometimes the enlargement of the uterus in the case of a tumour may be so uniform as to suggest pregnancy, and when occurring in an unmarried woman, where there might be reason for concealment of pregnancy, the diagnosis may be fraught with considerable difficulty.

It should always be remembered that a woman with a fibroid growth may become pregnant, when the existence of the pregnancy may mask the presence of the tumour and vice versa. This type of case, often at an age when amenorrhœa might be explained by the menopause, may present great difficulty in diagnosis. A biological test for pregnancy may be necessary before deciding. Further reference to this is made on a future page (p. 953).

In addition, fibroids have to be distinguished from *conditions which cause excessive uterine hæmorrhage*—e.g. retained placental fragments, chronic endometritis, mucous polypi, chronic subinvolution, chronic metritis, metropathia and malignant disease of the body of the uterus. The final distinction between these conditions and fibromyoma is made by means of a microscopic examination of the material removed from the interior of the uterus by the *curette*. Short of this, a tentative diagnosis can often be made from the history and physical signs alone.

Other conditions which cause pelvic or abdominal swellings—e.g. tubal, peritonitic, parametritic, rectal lesions—have to be excluded. Consideration of the history and signs, and a careful bimanual examination, seldom leaves one in doubt regarding the diagnosis.

Treatment of Fibromyomata.—Small tumours which give rise to no untoward effects may not require treatment. If discovered accidentally, the patient should not be informed of their presence, for it is difficult to persuade a patient that the presence of a tumour or growth may be unattended by any risk whatsoever. In such cases it is well, however, to explain matters to the husband or some relative, so that, in the event of the growth causing symptoms at a later date, the patient may not blame the doctor but be encouraged to seek further advice.

Non-operative Treatment.—In some cases there are no symptoms or these are insufficient in severity to justify an operation. Occasionally the existence of some disease of kidneys or heart, for example, may render the patient an unsuitable subject for operation.

Ergot or ergometrine given in repeated daily doses may control bleeding to some extent, though its influence in this respect is usually slight; instead of having a beneficial effect it may aggravate the bleeding in the case of submucous fibroids. As regards pain, while rest in bed may relieve it, this symptom, if a prominent feature, usually denotes degeneration or severe pressure, and, in the majority of cases, indicates the need for operation. Generally speaking, therefore, if a patient seeks medical advice and a fibromyoma can be presumed as causing the symptoms, the sooner the fibromyoma is removed the better.

X-Rays and Radium.—The employment of this treatment has been extensively applied in some quarters as an alternative to operation, X-rays and radium being used individually or in combination. The beneficial action of these agencies depends upon a twofold principle. In the *first* place the rays exert a direct destructive influence on the cells of the tumour, or are reputed to do so, inducing retrogressive changes which may result in atrophy of the growth. In the *second* place the rays exert an indirect influence by virtue of the destructive action they have on the follicles of the ovary. By destroying ovarian function atrophy of the uterus and of the fibromyomata incorporated with it occurs. This effect can operate only before or at the menopause, not later.

To-day gynaecologists employ X-rays only in exceptional circumstances and radium very seldom indeed for the treatment of fibromyomata. The cases most suitable for X-ray treatment are patients about forty years of age in whom the fibromyomata are relatively small and the chief symptom is hæmorrhage. The menopause is imminent in any case. Radium is not so suitable. Intrauterine employment of radium may have little effect if the tumour is of any size; then if it is distorting the cavity it may be difficult to introduce the container; and lastly the surface necrosis which results from the employment of intrauterine radium may be followed by infection.

Neither X-rays nor radium should be employed where degenerative change, especially malignancy, is suspected, where tumours are large and are causing pressure symptoms, or have undergone axial torsion. Furthermore, both treatments are contraindicated in early and middle reproductive life—*patients in this category should be treated by myomectomy* unless conditions are such that this conservative operative procedure is impracticable. Hysterectomy is then the operator's only choice unless the patient's general condition negatives operation of any kind.

The details of the technique of radiation treatment are referred to later (p. 1168). During the treatment the patient should be seen from time to time by the gynaecologist, so that the development of any untoward symptoms or signs may be recognised.

Operative Treatment.—The *indications* for operative interference in the case of fibromyomata are as follows :—

- (1) Large tumours in the abdomen.
- (2) Pelvic tumours causing pressure.
- (3) Rapid growth.
- (4) Intractable hæmorrhage.
- (5) Degeneration.
- (6) Torsion.
- (7) Persisting sterility in a young married woman.

To this list of indications we must add (8) an associated salpingitis. In another section we have indicated that, under ordinary conditions, tubal infection causing acute symptoms should be treated palliatively and not operatively (p. 1029). The combination of fibromyoma of the uterus and salpingitis makes the latter resistant to palliative measures, and whilst operation should be delayed, for the purpose of giving an opportunity for the infection to pass the acute phase and become quiescent, unfavourable developments may necessitate early recourse to operation.

The operation to be employed depends upon a series of circumstances: the age of the patient, the main symptom, the site, whether it is in the cervix or in the body, whether it is sub-mucous or subperitoneal, whether it is associated with malignancy, and so on.

Myomectomy with conservation of the uterus has been perfected and has replaced *hysterectomy* in many cases. It is the ideal operation during the reproductive phase of life.

Not only may all ordinary symptoms be relieved by myomectomy and the patient's general condition improved, but in many instances sterility has been corrected and pregnancy has occurred.

The details of the various operative procedures are given in Chapter LVI (p. 1100).

Fibromyomata and Pregnancy.—The presence of fibromyomata in

the uterus is undoubtedly an important causative factor of sterility, as has already been expressed (p. 820).

Pregnancy is more likely to take place where the tumour does not encroach on the uterine cavity, and it is therefore more common with subperitoneal and intramural growths (Fig. 374).

Fibromyomata as a complication of pregnancy has been referred to in Chapter XIV (p. 294); as a complication of labour in Chapter XXXI (p. 549); and as a complication of the puerperium in

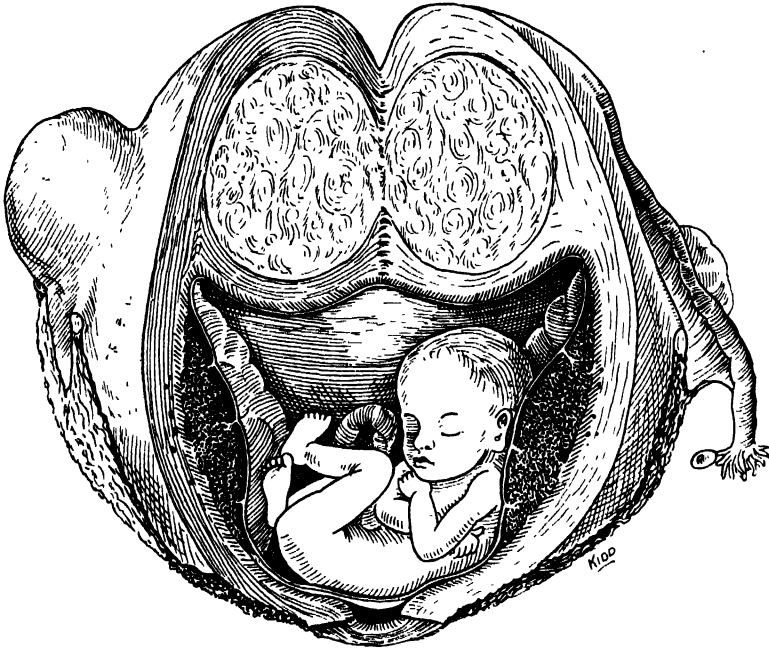


FIG. 374.—Pregnancy in a Fibromyomatous Uterus.

(Chapter XXXVII (p. 664). Here we summarise the general principles which should guide one in dealing with these tumours in pregnancy and labour.

1. In only about 10 per cent. of cases are fibromyomata of serious clinical significance encountered in pregnancy labour or the puerperium.
2. By careful supervision, in respect to diet, elimination and rest, the most unpromising cases may be carried through pregnancy.
3. A considerable number have a spontaneous delivery.
4. Where the tumours will obviously obstruct labour, pregnancy should be supervised until near term when Cæsarean section followed by myomectomy or hysterectomy, whichever is deemed necessary, should be performed.
5. In cases in which an operation must be undertaken in pregnancy,

myomectomy is the ideal procedure and especially if the patient is a primigravida. The results are excellent and the incidence of abortion following the operation is not more than 10 to 20 per cent.

6. Conservatism in treatment is stressed, more especially in respect to the primigravida, because this pregnancy may be her only chance of securing a child.

7. In dealing with a case in which pregnancy and fibromyomata are suspected to coexist, it is important to clear up all doubt on the question. If the existence of pregnancy is the uncertainty and it is not possible by ordinary clinical methods to come to a conclusion because of the presence of the tumours, an Aschheim-Zondek test should be made. On the other hand, if pregnancy is a certainty but doubt exists as to the presence of fibromyomata, careful palpation will generally enable one to come to a decision. There is, however, little need for concern if doubt still remains, because in such circumstances pregnancy will almost certainly proceed undisturbed and there will be no difficulty with the labour. The patient must naturally have careful supervision throughout pregnancy and the confinement.

III. ADENOMYOMA

This simple new growth of the uterus combines the structure of an adenoma with that of a myoma. The glandular elements reproduce exactly the structure of the normal endometrial glands, and have also a surrounding of tissue which is an exact replica of the normal stroma. The term *endometrioma* or *endometriosis* has, for that reason, been applied to this tumour, for it contains the complete structure of the endometrium. The term *endometrioma* is, however, usually reserved for the more specialised growth in the ovary (p. 1015), so, throughout the following pages the term *adenomyoma* is employed.

Surrounding the endometrial elements there is increase of muscle tissue (myoma element) and to a lesser extent fibrous tissue. This element may be merely the natural hypertrophic reaction to the presence of the endometrial tissue in its foreign situation. On the other hand, as sometimes it is present to a marked degree when the adenomatous tissue is scanty, it may be neoplastic. The endometrial elements of this growth undergo the menstrual changes characteristic of the normal endometrium. They also undergo decidual change if pregnancy occurs.

Adenomyoma of the uterus closely simulates fibromyoma and, in fact, often it is not appreciated that the tumour belongs to the former category until it is examined following operation. Over a large series it was found that one case of adenomyoma of the uterus was encountered for every forty-five cases of fibroids. As the tumour is not encapsulated failure to enucleate it should lead immediately to

a correct diagnosis, but, unless an attempt at myomectomy is made or careful examination of the uterus is carried out after hysterectomy, there is a possibility of the growth being mistaken for a fibromyoma.

Adenomyomata are occasionally found in an extrauterine site, especially in the broad, round and ovarian ligaments, and in the space between vagina and rectum (pp. 957, 1050).

The causation of adenomyoma in the female pelvis, like that of fibromyoma, is unknown. The exact origin of the glandular elements which gives the tumour its characteristic feature has been the topic of considerable discussion and research. In the case of adenomyoma in the uterus it is believed that the glandular elements are derived from the mucous membrane lining the uterine cavity. This, by some, is ascribed to adventitious congenital relics of mucosa situated in the muscular wall; by others, to an incursion of the mucous membrane outwards from its usual site in response to an inflammatory or other stimulus.

In the same way an adenomyoma growing in an extrauterine site is believed to be derived from congenital relics of the Müllerian system present in these sites, or to be of inflammatory origin. The more recent and most likely explanation is that, by regurgitation of endometrial fragments along the Fallopian tubes, implantation growths arise in these sites. This harmonises with the ovary and rectogenital space being the most common extrauterine sites. The rectogenital space is the most dependent part of the peritoneal cavity and into it fragments would naturally gravitate, and the ovaries commonly occupy a very low position in this pouch. This theory cannot explain the uterine tumours. On an analogy with the changes at the cornu of the uterus in cases of chronic salpingitis (salpingitis isthmica nodosa) when, as a result of inflammatory processes, there is nodular thickening with dislocation into it of islets of epithelium from the tubal mucosa (a picture very similar to adenomyoma of the body of the uterus), it is very difficult to rule out the influence of inflammatory reaction. In addition, it has been maintained that the glandular elements of an adenomyoma of the uterus can be traced back to the endometrium if serial sections of the uterine wall are made.

Adenomyoma of the Uterus.—Two varieties are recognised, the diffuse and the circumscribed.

DIFFUSE ADENOMYOMA.—This is the more common variety (Fig. 375). It takes the form of a swelling of the uterine wall which, on section, presents the general features already described as characterising a fibromyoma, but from this it is sharply distinguished by the gradual manner in which the growth merges into the surrounding muscular wall of the uterus—definitely it is not encapsulated. The posterior wall of the uterus is more commonly affected than the anterior. The neoplasm is denser on section than the healthy muscular wall, and from

this it can usually be recognised by its paler structure and by the whorled arrangement of its fibres. In bottled specimens the cut surface may, on close inspection, show innumerable cystic spaces about the size of a pin-head.

Cystic changes in its substance are not uncommon, the cavities being lined by a smooth membrane. In some cases the affected wall of the uterus is expanded by one or more large spaces of this sort, formed by distension of the gland spaces in the substance of the growth (Fig. 376).

In other instances spaces of varying size and filled with a viscid chocolate - coloured material derived from altered blood are found in the substance of the neoplasm. These are due to menstrual extravasations which have occurred into portions of

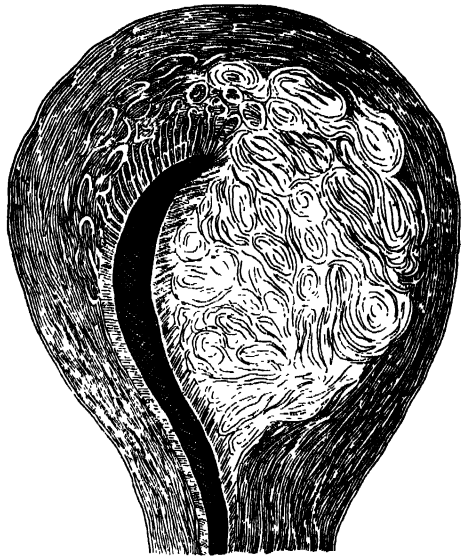


FIG. 375.—Diffuse Adenomyoma of Uterus.

the mucosa imbedded in the growth and which have no outlet (Fig. 378).

Degenerative changes similar in nature to those which have been described as involving fibromyomata may occur in adenomyomata.

Microscopic Appearances.

—The main mass of the tumour consists of fibromuscular tissue indistinguishable in most cases from that present in the healthy uterine wall. The gland spaces are scattered irregularly throughout its substance, their numbers varying in different tumours and in different parts

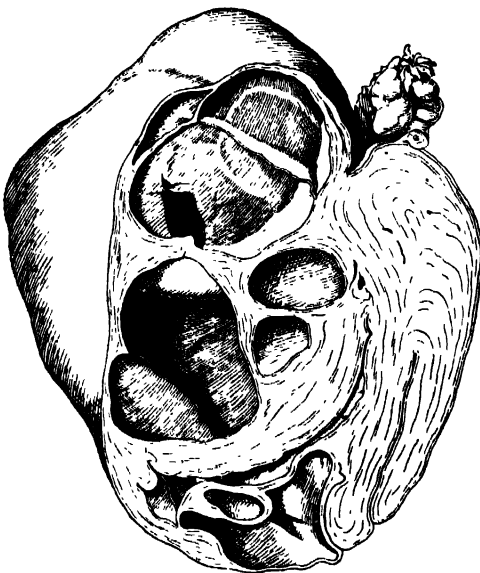


FIG. 376 — Cystic Adenomyoma of Uterus.

of the same tumour (Fig. 377). The epithelium lining the acini is of the columnar type similar to that found in the endometrium; and in their size and general structure the glands cannot be distinguished from

those of the mucosa of the corpus uteri. The glands are surrounded by a stroma exactly resembling that present in the endometrium.

The origin of the gland elements and their enveloping stroma from the uterine mucous membrane can, in some cases, be traced directly in the microscopic sections, when fine streamers of the two component elements of the mucosa can be seen spreading outwards into the growth.

Where cysts are present they are found to be lined by a columnar epithelium except where, in the larger cysts, this has become flattened by the tension of the accumulating fluid.

CIRCUMSCRIBED ADENOMYOMA.—This is a rarer variety. It forms a localised

growth which, at or after operation, may be difficult to distinguish from a fibromyoma if absence of capsule is not noted. It may be found in any part of the uterine wall. It takes the form of



FIG. 377.—Adenomyoma.

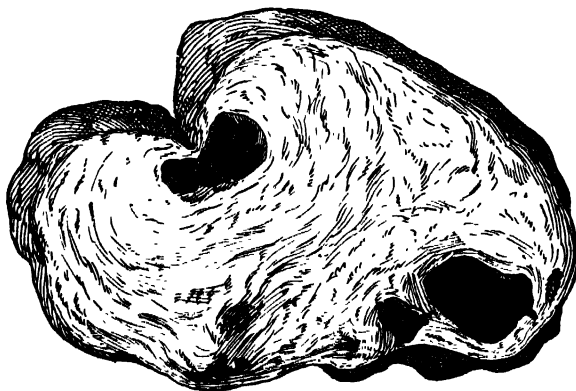


FIG. 378.—Adenomyoma with Blood Spaces.

solid rounded mass usually visible on the outer surface of the uterus.

On section the growth in its most usual form is fairly sharply outlined and consists of tissue possessing a paler colour than the surrounding uterine wall.

Microscopically the circumscribed adenomyoma presents appearances in no wise different from those exhibited by the diffuse tumour.

In its general features the circumscribed adenomyoma resembles the solid tumour-like mass which, not infrequently, develops in cases of chronic salpingitis—so-called *salpingitis isthmica nodosa*. In this condition there is formed a mass of tissue derived from an overgrowth of the fibromuscular tissues of the tube wall adjacent to the uterus; into this, incursions of gland elements pass from the mucous lining. In these cases there is definite evidence pointing to their inflammatory origin—*e.g.* round-celled infiltration, etc.—and where tubercle is the cause, as is most frequently the case, typical tuberculous follicles are found (*vide* p. 1032).

The facts just stated lend plausibility to the view which finds acceptance in some quarters that adenomyoma itself has an inflammatory origin, though the usual recognisable evidences of this may become obscured or even disappear after a time.

SYMPTOMS.—The symptoms are similar to those associated with fibromyoma. Dysmenorrhœa is definitely more common and more pronounced. In married subjects, sterility has a higher incidence than in fibromyoma. Secondary changes and symptoms due to these do not merit discussion here as, from what has been stated (p. 953), this type of tumour is obviously relatively rare.

TREATMENT.—A small tumour may be removed by excision. For larger growths hysterectomy (subtotal or total, depending upon the site and size of the tumour) is required. Alternatively, if there is a condition contraindicating operation, radiation may be employed (p. 950).

Extrauterine Adenomyomata.—Although this chapter deals with uterine tumours it is deemed advisable to refer to these growths at this stage as they are of the same type and structure as originates in the uterus. Endometrioma of the ovary receives special mention in its own section (p. 1015). Their origin has been discussed a few pages back (p. 954).

ADENOMYOMA OF ROUND LIGAMENT.—This is a rare form of tumour in any part of the ligament. When it develops at the anterior end it forms a swelling which may bulge through the inguinal canal and project into the labium majus. In this site it may be confused with a hernia or lipoma. A feature which is sometimes present distinguishes it at once; swelling and tenderness of the tumour recurring each month with menstruation.

ADENOMYOMA OF OVARIAN LIGAMENT.—This is a very rare growth.

ADENOMYOMA OF BROAD LIGAMENT.—This also is rare and cannot be distinguished from a fibromyoma (a type of growth quite commonly found in this site) except by microscopic investigation.

ADENOMYOMA OF RECTO-VAGINAL SPACE.—In this site the tumour tissue arises in the space between cervix and vagina in front and

bowel behind. It extends by irregular diffusion, forming a mass which bulges into the posterior vaginal fornix and spreads backwards until the rectum may be surrounded and its lumen narrowed. It is rare for the tumour elements to grow through the vaginal wall and present in the vaginal vault. Should this occur it may exhibit a papillary character, and the soft, wart-like projections may be a source of vaginal hæmorrhage. In this way it may simulate a carcinoma of the cervix or vaginal wall. In such cases a certain diagnosis can be arrived at only by the removal of a piece for microscopic examination. Where the growth envelops the rectum, as it usually does, it may give rise to symptoms simulating those of carcinoma of the rectum.

SYMPTOMS.—Extrauterine adenomyomata situated in the round and broad ligaments can seldom be distinguished from fibromyomata which (although rarities) are the commonest growths found in these localities. An adenomyoma in the recto-vaginal and recto-cervical areas may cause pressure on, and even obstruction of, the bowel. Dyspareunia is a very usual feature (p. 812). *One symptom of adenomyoma of the recto-genital space is particularly characteristic, viz., pain on bowel movement during the premenstrual phase.* The congestion with swelling of the endometrial elements in the growth, natural to this phase, would appear to be responsible.

TREATMENT.—Excision should be carried out in suitable cases. This is always practicable when the tumours are situated in the round, ovarian or broad ligaments. With the recto-vaginal growth, excision should be carried through healthy tissue all round. Where the rectum is involved, a sufficient removal to relieve constriction of the bowel is necessary: excision of the gut may be required on occasion but this should be avoided if at all possible. Sometimes excision of the tumour, on account of the danger of puncturing the bowel, is inadvisable. Radium may be employed, and is to be preferred, the nearest approaches are by the posterior fornix and the bowel lumen (p. 1050).

CHAPTER XLIX

DISEASES OF THE UTERUS (*continued*)

MALIGNANT TUMOURS OF UTERUS

CARCINOMA—SARCOMA—CHORIONEPITHELIOMA

INTRODUCTORY

CARCINOMA is the most frequent malignant growth affecting women. The two commonest sites of origin are the *mammæ* and the uterus. The relative frequency in these two sites is approximately equal. It is estimated that about 30 per cent. of all *cancers* in women originate in the uterus, of which 75 to 80 per cent. originate in the *cervix* and 20 to 25 per cent. in the *corpus*. Next in frequency to *mammæ* and uterus as sites of origin come ovaries, and intestinal tract, followed by vulva, vagina and Fallopian tubes. Carcinoma (primary) in the last two sites is very rare indeed.

The two other malignant growths affecting the uterus—sarcoma and chorionepithelioma—are relatively rare, as can be judged from the following table :—

TABLE.—SERIES OF 979 CASES OF MALIGNANT DISEASE OF UTERUS.
ROYAL SAMARITAN HOSPITAL, GLASGOW (1928-37 INCLUSIVE)

Carcinoma	Cervix	747	...
	Corpus	208	955
Sarcoma	Cervix	1	...
	Corpus	2	...
	Associated with fibromyomata	11	14
Chorionepithelioma . .	Corpus	10	10
		—	—
Totals		979	979

CARCINOMA OF UTERUS

The appearance (naked-eye and microscopic) and clinical features of carcinoma of body and of cervix are quite different. In part this is due to origin in, or from, a different type of epithelium ; in part to a different environment for the growing tumour. In the body of the

uterus the tumour grows usually in aseptic surroundings, while on the vaginal surface of the cervix it is exposed to infection from its earliest stage. Moreover, in the latter situation it is more liable to trauma. The body cancer is as a rule highly differentiated; and for that reason the growth remains localised to a later stage than in the less differentiated tumour of the cervix. By highly differentiated is meant that the tumour cells more nearly reproduce the normal appearance and arrangement and thus may retain to some degree the power of functioning.

When loss of function and sacrifice of everything to reproduction occurs as in cancers, change in cell structure and arrangement of cells takes place. Under these circumstances, referred to as *anaplasia* or *dedifferentiation*, it is not surprising that finger-like extensions of the growth pass out beyond the site of origin (infiltration) and small masses

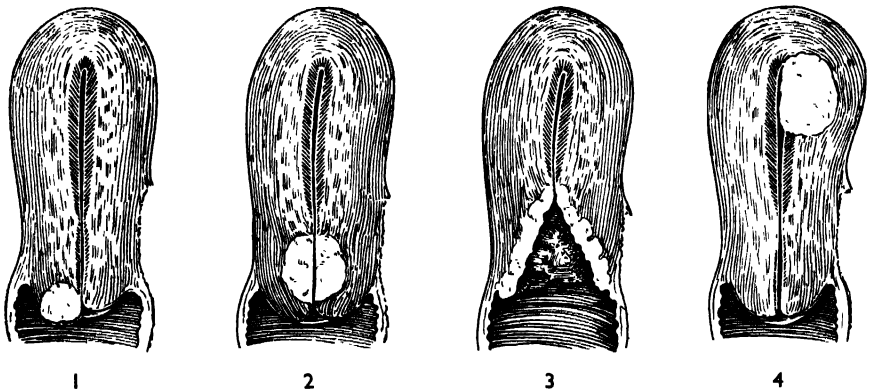


FIG. 379.—Sites of Origin of Cancer of Uterus (diagrammatic).

of cells in their hurried proliferation break off to be carried away in the lymph stream to settle and grow in the nearest point at which their journey is arrested (metastases in lymph glands). Often their journey is extended so that secondary growths occur in distant glands or other organs—it is important to remember that this occurs much later in cancer of the body than in cancer of the cervix, a matter which influences prognosis and method of treatment. Furthermore, the growth in the cervical canal (endocervical variety), which has the protection from infection possessed by the body cancer (delaying the onset of symptoms) and has the power of early extension possessed by the cervical growths, has the worst prognosis.

Fig. 379 represents diagrammatically the various sites of origin and arrangement of cancer of the uterus. No. 1 demonstrates cancer of the vaginal cervix. Endocervical cancer is depicted in No. 2, while No. 3 represents the crater-like ulcer replacing the cervix, which is a late stage of either 1 or 2. In No. 4 we have adeno-carcinoma arising from the endometrium of the body of the uterus.

Malignant disease of the uterus, which occurs in all races and which takes a heavy toll of female life annually, is now considered in order of frequency and correspondingly, therefore, in order of importance.

CARCINOMA OF CERVIX

Ætiology.—Multiparous women are more prone to cancer of the cervix than nulliparous women. Of the series in the foregoing table (p. 959) 3 per cent. were unmarried and only 4 per cent. of *all* cases of cancer of the cervix were nulliparous. Of those who were parous the average number of pregnancies was just over six (of which one was an abortion). This is a slightly higher rate of parity than for the community in general.

Predisposing Factors.—*Laceration* of the cervix and *chronic inflammation*, such common sequelæ of labour, have been cited as the predisposing factors. Associated with these lesions we have *erosion* of the cervix or, as a result of *ectropion*, exposure of the delicate columnar epithelium of the cervical canal to the vaginal canal. Whether as erosion or as a result of ectropion, this columnar epithelium finds itself in a foreign environment, exposed to trauma and invasion by organisms always present in the vaginal canal. This may furnish a chronic irritation, a factor recognised as predisposing to malignancy. In the case of an *erosion* we know that the epithelial balance is never stationary—the squamous epithelium replaces the columnar as healing occurs, and then the columnar replaces the squamous as the erosion again extends. There is in consequence constant striving in growth between the two types of epithelium, a circumstance which might set up an excessive and unstable proliferation.

By whatever agency *multiparity* acts, and its influence cannot be questioned, it acts slowly. One of the most striking features of the association of cancer of the cervix with parturition is the long interval between the preceding pregnancy and the recognition of the tumour. In the series already considered the average interval was fifteen years.

Accepting *trauma* in childbirth as the important cause of chronic inflammation of the cervix, figures have been advanced to show that repair of cervical lacerations reduces the incidence of cancer (p. 772).

We have the impression that this disease is more common amongst the hospital class than in private practice.

The student should remember that the foregoing remarks refer to factors influencing the incidence of cancer of the cervix, *not to the cause of cancer*, which, as all are aware, is still unknown.

Having endeavoured to point to some connection between laceration and chronic infection of the cervix, we must now mention prolapse. In this condition, when well established, the cervix and vaginal walls are exposed to friction against the thighs and clothing or possibly some form of T-bandage improvised by the patient; yet, while simple

chronic ulceration is common, it is exceptional to meet with cancer of the cervix or vagina in such cases (p. 843).

Carcinoma of the cervix is sometimes encountered in women who have had a pessary in the vagina over a long period. Pessaries very frequently are responsible for setting up irritation, chronic inflammation and discharge; but there is no proof that the incidence of cancer of the cervix is higher in such women than in women who have never worn a pessary.

It has been argued that, when for any reason (*e.g.* fibromyomata) hysterectomy is performed, the entire cervix should be removed along with the body of the uterus (total hysterectomy) on account of the liability of cancer developing in it. Proof has not yet been furnished that the cervix without the body of the uterus is any more liable to develop a malignant tumour than the cervix from which the body has not been removed. If due care is taken to exclude an already existing cancer of the cervix, solely to avoid the occurrence of a cancerous growth, it does not seem justifiable to supplant, in all cases, subtotal by total hysterectomy with its slightly higher mortality. On the other hand it may be argued that removal of the cervix excludes the possibility of a future development of cancer in the cervix.

The *average age* at which patients show symptoms of this disease is fifty years. The incidence declines both below and above this age. Taking into consideration that there are fewer alive over than under fifty years of age, it is probable that the liability to cancer of the cervix increases steadily with age. *There is practically no age limit for this tumour, but it is rare under thirty years.* It is said that the younger the patient the more rapid will be the progress of the growth. This has been our experience. In very elderly women its progress to a fatal termination is in many instances very slow. This is a point to remember in deciding on method of treatment.

Pathology.—Cervical cancer may arise either from the squamous epithelium which covers the vaginal portion of the cervix—*cervical carcinoma*—or it may grow from the columnar epithelium covering the surface or that lining the glands of the mucosa of the cervical canal—*endocervical carcinoma*. Accordingly it has commonly been taught that carcinoma arising in the portio vaginalis is a squamous-cell cancer and that endocervical cancer arising in the cervical endometrium is an adeno-carcinoma. Theoretically this simple classification is most satisfactory, but as a histological maxim it is unfortunately not tenable. Indeed, it is often impossible to determine, either by clinical investigation or by microscopic examination, whether a cancer originated in the squamous epithelium of the portio vaginalis or in the cervical endometrium. This difficulty arises because of the tendency of the epithelium of the cervical canal to undergo metaplasia. Chronic inflammatory changes of the cervix frequently cause the columnar epithelium to revert to the more primitive squamous type, and so,

too, squamous-celled carcinoma is *apparently* found to have arisen from the columnar cells of the cervical endometrium. In view of this fact it will be readily appreciated that the large proportion of cases of cancer of the cervix are classified as of the squamous-cell type.

Another approach to this question would be—Is a cancer which originates from columnar epithelium entitled to be called an adenocarcinoma irrespective of the subsequent structure or character of its cells? If the columnar epithelium or the squamous epithelium retained its normal appearance and function this would not constitute a malignant tumour. In the presence of established malignancy both forms of cells have reverted to a more primitive type and have sacrificed all to rapid proliferation. The appearances of the two types approximate to one another and become in the malignant growth indistinguishable from one another. In the case of the columnar cell it becomes spheroidal and acinous arrangement is lost. In the absence of these two features the tumour is liable to be classified as of squamous-cell origin.

Of cervical cancers only 4 to 5 per cent. have a recognisable glandular arrangement enabling one to label them "adenocarcinoma"; but this is no indication of what proportion of cancers originate in (a) the epithelium of the cervical canal, surface or glands; in (b) the columnar epithelium of an "erosion" of the cervix.

SQUAMOUS-CELLED CANCER. — Statistics relegate at least 95 per cent. of cases of cancer of the cervix to this group which presents several clinical types. The type most frequently seen commences with infiltration of the cervical tissue by downgrowths extending from the epithelium of the *portio vaginalis*. With this new formation of tissue the cervix becomes enlarged in circumference and nodular in outline (Fig. 380). The invasion of the deeper tissues is followed by ulceration of the surface of the *portio vaginalis*, while septic infection soon occurs. The surface of the ulcerated area is friable.



FIG. 380. Carcinoma of cervix. Proliferation has predominated to date with broadening of vaginal portion of cervix but little ulceration so far. Growth has extended round external os. Surface nodular. Histologically there was evidence of adenomatous origin. (Almost conforms to diagrammatic representation, Fig. 379, 2.)

It breaks away easily and bleeds on examination or on other interference, such as coitus. Infection gives rise to a copious foetid discharge.

As destructive ulceration continues on the surface, proliferation advances in the deeper tissues, so that as the tissues break away superficially the cancer extends centrifugally in widening circles. In the course of time it thus happens that the cervix may be reduced to a mere shell or may be completely destroyed, leaving a ragged, foul, crater-like cavity in the vault of the vagina (Fig. 381).

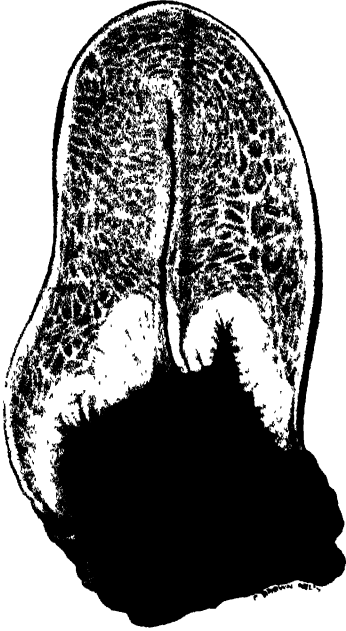


FIG. 381.—Carcinoma of cervix. Advanced stage. Exact site of origin uncertain. The cervix has been invaded deeply and the resulting tumour has broken down, leaving only the advancing margin of the growth. Surface extension to the vaginal walls has taken place. (Represented diagrammatically in Fig. 379, 3.)

Extension to the vaginal wall occurs comparatively early. The growth may extend upwards into the uterine body, but very commonly it is arrested temporarily at the internal os. Sooner or later the parametrium becomes invaded, causing induration of this connective tissue and limiting mobility of the cervix. The adjacent viscera become involved. If the extension is in front the bladder is infiltrated, causing cystitis and eventually hæmaturia, and, in the later stages, destruction of tissue leads to the formation of a fistula between vagina and bladder (vesico-vaginal fistula). When the line of growth is backwards the rectum is involved and a recto-vaginal fistula is produced. Ultimately infiltration of the pelvic cellular tissue is liable to cause constriction or blockage of the ureters which may lead to the production of hydro-nephrosis, pyelo-nephritis, suppression of urine and uræmia. It occasionally happens that the growth

obstructs the cervical canal, causing purulent discharge to be pent up in the uterus. This condition is known as *pyometra*.

Metastases in lymphatic glands occurs early. The local glands, namely, the iliac, hypogastric, sacral and lumbar groups, entirely or individually, are said to be involved in one-third of the early cases and in two-thirds of the advanced cases. It occasionally happens that these glands are not involved and yet metastases may have occurred in some distant organ. Compared with other cancers remote metastases are comparatively rare—the commonest sites are peritoneum, bones, liver and lungs.

The fact that a lymphatic gland is enlarged does not necessarily

imply that the enlargement is due to malignant disease. Lymphatic glands may become enlarged from infection. A microscopic examination of the gland tissue is necessary before one can pronounce for or against malignant invasion.

Another type less frequently seen is that commonly known as *cauliflower* cancer of the cervix. Arising from one or other lip of the cervix, it extends downwards into the vagina as a proliferating friable growth. Necrosis occurs early and the tumour appears as a dirty sloughing mass accompanied by profuse foul-smelling discharge. *This type is less liable to involve the pelvic cellular tissue at an early stage.* Extension in the early stages is usually confined to the vaginal wall to which the growth may spread either by direct continuity or, less likely, by contact-implantation. Ultimately, however, the cancer cells penetrate to the paracervical tissue or through the vaginal mucous membrane to the paravaginal tissue.

Yet another type occurs as a *flat ulcer*. It is rare and is usually seen in elderly women. The ulcer has a firm, elevated edge and has been likened in appearance to a rodent ulcer. It has less tendency to deep penetration of tissue, and for this reason patients suffering from this type have been known to live for many years after the disease has been diagnosed.

ADENO-CARCINOMA.—This form arises either from the epithelium lining the cervical canal or from the cervical glands (*vide* p. 963). The latter is said to be the commoner site. The tumour in the earliest stages extends into the cervical tissue as tubular ingrowths. It is much less common than the squamous type. Its incidence is given as 4 to 5 per cent. The difficulty of identifying tumours originating in the columnar epithelium of the cervix has been mentioned already. We might add here that with radium treatment supplanting operative treatment, less opportunity is given for proper histological examination of these tumours. Opinion often is formed from examination of a portion of the most accessible part, an area which commonly has undergone necrotic changes.

Microscopical Features.—*Squamous epithelioma* of the cervix has the general appearances presented by this type of growth in other parts of the human body. There are solid masses of cells growing into the subjacent tissues, which reproduce in varying degree the characters of the cells from which they are derived (Fig. 382). Keratinisation of the epithelium is uncommon in the cervix, and cell-nests are, therefore, not so typical as in squamous epithelioma growing in other sites—*e.g.* the skin, vagina, etc. When cell-nests are a feature, the possibility of the tumour being primarily of vaginal origin should be kept in mind.

Adeno-carcinoma may arise low down in the cervix, and if the cervical lips are spread apart by laceration, and the lining mucosa is exposed in the vaginal vault (ectropion), the cancer may arise on the surface exposed to the vagina. It may originate in the concealed part

of the canal (endocervical carcinoma). Whatever its site of origin, some area of the growth coming under microscopic examination will show an adenomatous arrangement either perfect or imperfect which will permit of relegating the tumour to this type. In the former site, clinically, it may exactly simulate a squamous epithelioma growing from the vaginal surface. In the latter site it remains shut in during a considerable period of its growth and an advanced cancer may be present with no great alteration of the cervix except a broadening. As in cancer of the surface aspect of the vaginal portion, the endocervical cancer may on rare occasions bulge into the canal in the form of papillary growths, or more rarely still it may from the beginning be ulcerative. In either case destruction of tissue occurs, though, as infection does



FIG. 382.—Squamous Epithelioma of Cervix.

not so readily occur here as in an exposed cancer, the destructive process may be slower. When ultimately ulceration and breaking down of tumour tissue occurs, a crater-like cavity replaces the cervix (Fig. 381, p. 964).

Extension upwards into the wall of the body of the uterus may occur later. The formation of *pyometra* already mentioned is more likely than in cancer of the vaginal surface of the cervix. Infection may traverse the uterus to the tubes and ovaries, causing *salpingo-oöphoritis*.

Two different appearances may be presented by columnar-celled carcinoma: (a) *Adeno-carcinoma*. Here the epithelial cells in their growth retain their acinous arrangement. (b) *Solid or alveolar carcinoma*. Here the adenomatous arrangement is lost, and the cells proliferate in the form of solid masses, which may prevent it being recognised as being of columnar-cell origin. In advanced cases of cervical cancer

usually it is impossible to tell either by clinical or by microscopic examination the exact site of origin.

The lymphatic glands which are involved in cancer of the cervix are (1) the glands which lie where the ureters cross the uterine vessels, (2) the iliac glands on the external iliac vessels, (3) the hypogastric glands between the external and internal iliac vessels, (4) the sacral glands and (5) the lumbar glands.

Attempts have been made to classify cancer of the cervix into groups according to the type of cell composing the tumour. It is not proposed to burden the student with minute histological details. Several cell types have been described, but all may be, and frequently are, found in the same tumour. It may be said that, at present, histological classification according to cell types is of little assistance as a guide to treatment or prognosis. The obviously adenomatous cancer can always be identified, but even this definite finding has little value. As it is more highly differentiated it is supposed to be less malignant (more likely to be localised), but is less radio-sensitive, and radium therapy is now that most commonly employed. This may, to some extent, explain why there is difficulty, as will be mentioned later, in correlating types of growth and results from treatment by irradiation. Eventually the highly expert gynaecological pathologist may be able to give us valuable guidance regarding treatment and prognosis, but at present both of these are more surely based on clinical data.

In our investigations of this dread disease analysis of results of treatment over a long period is essential. An attempt to classify or grade cases was made by the League of Nations Health Organisation, so that equable comparison of results could be made. In their grading, histological appearance was not considered. Extent of neoplastic spread was taken as the basis. This will receive consideration later in reference to treatment and its results, but meantime we might mention the clinical types of cervical growth specified in the scheme. These are (1) small ulcer, (2) cauliflower, (3) nodular cervix, (4) endocervical crater, (5) worm-eaten cervix.

The nodular cervix appears to be a stage between (1) and (2)—*e.g.* marked proliferation, but with enlargement of the cervix rather than projection of the mass into the vagina (Fig. 380). No. 4 is the broken-down cervical type leaving a crater at the vault of the vagina (Fig. 381). No. 5, worm-eaten cervix, is the endocervical type in which the cancer is still confined around the cervical canal and has not yet broken down at the external os to form an area of ulceration.

Clinical Features.—The three cardinal features of cervical carcinoma are: (1) Discharge, (2) Hæmorrhage, (3) Pain, and on average they appear in the order named.

The *discharge* in the beginning is scanty, watery and irritating. Later it becomes very foetid, and the smell may be a source of great distress to the patient. Although discharge is the first symptom

it does not seem to incite women to seek medical advice, so that in nearly all cases hæmorrhage has commenced before the patient comes under observation and treatment.

Hæmorrhage results from destruction of the superficial tissues. Like the foul-smelling discharge it is an earlier symptom in cancer of the vaginal portion than in concealed cancer of the cervix. The reasons for this are obvious, the exposed cancer is more liable to infection and trauma. Even at an early stage digital examination and coitus both tend to induce bleeding. *We would stress the importance of a history of bleeding following coitus.* At a later stage the blood-stained and offensive discharge may be almost continuous, causing anæmia and exhaustion. Fatal hæmorrhage is rare.

Irregular and intermittent hæmorrhage in a woman, especially if over forty years of age, should always be considered as due to malignant disease until this has been positively excluded. The occurrence of vaginal hæmorrhage, after the menopause has been established for some months or years, is, in 50 to 60 per cent. of cases, due to malignant disease, the commonest form of which is cancer of the cervix.

Pain is a late symptom. The cervix itself is peculiarly insensitive, and so long as the growth is limited to it pain is absent. This symptom does not arise till spread occurs into the parametric tissue, to the vagina, or to the surrounding organs, especially bladder and rectum. *The onset of pain in the absence of other obvious cause should be taken to indicate that the tumour has spread well beyond the limits of the uterus.*

Cancer of the cervix is only rarely seen in its earliest stage. The late onset of pain, which with so many women seems to be the only indication to seek medical advice, is an important reason for this tragic fact. Another factor is that the incidence being at its maximum at or just after the menopause, irregular bleeding is believed by the patient to be usual at that stage of life.

The other symptoms depend on involvement of the adjacent organs. *Cystitis* is associated with pain and frequency of micturition. If fistulous formation with leakage of urine occurs, the resulting discomfort is aggravated by irritation of the vulva and thighs from the infected urine. *Uræmia* may develop from blocked ureters and this in a number of cases is the ultimate cause of death.

Anæmia usually is in proportion to blood loss. Sometimes, however, it is much more marked and in these cases the blood changes are also those of septic absorption. In the beginning, and in some cases throughout a considerable course of the disease, the *loss of weight* may not be appreciable, and a patient with an advanced cancer of the cervix may enjoy good general health for a surprisingly long time.

Sooner or later, however, exhaustion and *cachexia* set in, and it is from this in the majority of cases that the patient eventually dies, if not previously carried away by an infection of the kidney substance or peritonitis due to involvement of that membrane by the tumour

and subsequent infection. The hæmorrhage, persistent discharge and absorption from the septic surface all conspire in producing the fatal issue.

PHYSICAL SIGNS.—As general signs, *anæmia* and *emaciation* may betray the existence of some deep-seated disease.

The only conclusive sign of carcinoma is the evidence of the *microscope*, and this, the ultimate test, must be employed in every case. In early cases, on vaginal examination, nothing abnormal may be felt except a local *induration* or *roughening*, or a *wart-like elevation* on the surface of the vaginal portion of the cervix. The tissue is **FRIABLE** on the surface and crumbles if scraped with the finger-nail. In *intra-cervical carcinoma* there may be no detectable enlargement or other change in the cervix even up to a late stage, but in some instances it appears bulky and barrel-shaped and *when compressed* blood may escape from the external os.

Diagnosis.—Much has been written on the evidence of a pre-cancerous or extremely early phase of the disease. *Painting the cervix with a watery solution of iodine (Schiller test)* is recommended as a means of diagnosing cancer of the cervix in its early stages. The affected area remains white and does not take the dark colouring which the healthy cervical surface does. Other conditions such as syphilitic scars behave similarly, so that *this test merely indicates suspicious areas to be investigated by microscopic examination*.

Colposcopy (Hinselmann), direct inspection of the cervix under magnification, is a parallel procedure and may identify areas requiring biopsy. These are small white spots (leucoplakia).

Both procedures are useful, but will not bring cases, other than those encountered by accident, under treatment at an earlier stage unless routine examination of apparently healthy subjects is carried out.

The *blood sedimentation rate* has been investigated with a view to ascertaining if it has any value in the diagnosis of cancer of the cervix. At present it has not, nor is it an aid in prognosis. Similarly the blood picture is of no assistance. It is profoundly influenced by X-ray treatment. The most striking feature is a drop in the white cell count.

The average practitioner does not see a great many cases of cervical cancer, but having seen a few his diagnosis can be made with confidence in most instances. As the disease is generally advanced when first seen not more than 5 per cent. of cases require biopsy for diagnosis, but histological confirmation should be obtained in all cases even if there appears to be no doubt of the diagnosis.

The conditions which most closely simulate carcinoma of the cervix are erosion, tuberculosis, syphilitic gumma, and mucous and fibroid polyp of the cervix.

In *erosion* there may be enlargement, chronic thickening and induration, and the surface may bleed readily to the touch although

not to the same extent as in an established cancer. There is no friability, and on examination through a speculum the characteristic signs of erosion are visible. Sometimes the diagnosis may be obscure, and moreover cancer may complicate erosion. In such a case a microscopic examination is necessary.

In *tuberculosis*, and also in *syphilitic gumma*, the cervix may be the seat of a localised growth suspiciously like cancer—indurated, ulcerated and friable. Tuberculosis of the cervix (p. 878) is very rare and usually gross infection in other organs is obvious. In syphilitic gumma the history would furnish a clue to the possibility of this disease. Again microscopic examination is necessary.

Mucous and fibroid polypi are smooth growths detached from the cervix except for their pedicles.

Prognosis.—In the majority of cases cancer of cervix (untreated) is fatal within two years. Some elderly patients survive even to seven years or longer. It is unnecessary to stress the supreme importance of early diagnosis. It is no exaggeration to state that if the disease is diagnosed and treated (operation or radium) at a very early stage, a cure can be assured in the great majority of cases. With every week that passes the prognosis becomes more and more unfavourable (*vide* p. 974).

Treatment.—RADIUM AND X-RAYS. —Many gynæcologists have ceased to operate on cervical cancer because the results which can be obtained with radium and deep X-rays compare favourably with those claimed for operation. Radiation therapy possesses the advantage that it is much more available for routine use than operation, as the latter demands high surgical skill and experience. Even in the best hands there is a 4 to 6 per cent. operation mortality in very early cases and at least a 10 per cent. operation mortality in more advanced cases. Patients, further, can be expected to submit more willingly to treatment when this does not imply a severe operation. Moreover, radium treatment is a method available for early and late cases alike. *It is contraindicated in advanced cases, in which the walls of the bladder or rectum are involved by the cancer.* In these the necrosis produced by radiation will cause a fistulous opening between the bladder or rectum and the vagina. Another contraindication is present when stenosis of a ureter already exists.

There is not any question but that radium applied to a cancer of the cervix can, and in the vast majority of cases does, destroy the tumour. The local effect of the application of radium is nothing short of marvellous. The conversion of an irregular sloughing mass into a smooth vaginal cervix of normal contour within a few weeks is most impressive. In cases in which the cervical canal cannot be identified, if a "cleansing" dose of radium is applied to the tumour in the vagina, almost invariably in two to three weeks the canal can be found.

When a cancer commences in the vicinity of the external os in one

lip or side of the cervix, the os is eccentric in the mass presenting in the vagina. It is important that this should be borne in mind when difficulty arises in finding the cervical canal, an essential preliminary to treatment by radium, as part of the radium must be placed in the uterine cavity.

Radium and operative treatment have this in common—the difficulty in reaching the distant extensions of the growth in the cellular tissue, lymphatic vessels and glands. With radium these outlying malignant nests do not receive an exposure of the same intensity as the proximate tumour, just as by operation they may escape removal. Strenuous efforts are at present being made to equalise the dosage over all areas possibly invaded, and this is being tried out in various ways. Deep X-rays and the radium bomb are being employed to destroy extensions of the tumour to outlying parts by exposures through multiple ports of entry concentrated on likely parts. The difficulty is that of avoiding destruction of the intervening normal tissues so much nearer to the source of irradiation. The effect of radiation diminishes very rapidly as distance is increased.

Other methods include the insertion of needles through the vagina into the periphery of the growth; laparotomy and implanting of radium-containing tubes directly through the peritoneal cavity into retroperitoneal sites; marsupialisation of the pelvis to allow of free intrapelvic radium application; injection of silver emulsion in oil with radium emanation into parametrium and utero-sacral ligaments; insertion of radium through lateral perineal incisions (for more efficient distribution to the parametrium); and insertion of radium into the paracervical tissue after a circular incision of the vaginal attachment to the cervix, as at the commencement of a vaginal hysterectomy. While all these procedures carry the effects beyond the primary site of the tumour, nevertheless their effects are limited. Deep X-ray therapy or the radium bomb, when the technique is perfected, possibly hold out most hope of destroying the distant ramifications of a cancerous growth and of thus improving results.

Radium and X-rays act by destroying the cancer cells. Irradiation has little effect on the stroma. The cancer cells, in cases favourably influenced, undergo autolysis and resorption. Later there is cicatrization of the stroma. It is thought also that the surrounding normal cells, included in the stroma, may be stimulated to destroy the tumour cells. To achieve those effects at their maximum implies correct dosage. Considerable divergence of opinion exists regarding dosage, method of application, distribution, etc. Views cannot be formulated until results have been observed over a five years' period. Accurate records are therefore of the first importance.

Complications resulting from the local application of radium are: occlusion of the cervical canal or upper vagina with development of pyometra; proctitis, which is more immediate, and scar retraction

of cellular tissue constricting the rectum, which is more remote ; fistulæ opening into the vagina (vesical or rectal) ; and intoxication from rapid absorption from destruction of a massive growth.

Sepsis, extension from the tumour already infected, sometimes occurs. Peritonitis or pyæmia may result. Theoretically the previous preparation and administration of a vaccine would reduce the risk of danger from septic absorption from a tumour breaking down as a result of irradiation. The difficulty, however, is the isolation (from a sloughing mass in a septic cavity) of the organism likely to become dangerous.

Hæmorrhage of serious nature does occur, but is comparatively rare.

Blood transfusion is most valuable in cases in which hæmorrhage results after radium application, but it need not be employed in the most advanced stages of this disease. If a patient is in the last stages of a disease which usually is associated with great pain, and if she is obviously dying, narcosis is preferable to transfusion of blood. Blood transfusion may also be valuable before or after operation or even in raising the resistance of the patient before radium treatment or during deep X-ray therapy.

Cases have been treated with *radium during pregnancy* with apparently no ill effects to the child, but there is always the risk of such an eventuality. It is better to remove the child by abdominal hysterotomy and treat the cancerous condition by radium or by an immediate Wertheim's hysterectomy (p. 1117).

Details of Methods of Radium Application.—Radium is employed in the form of radium sulphate which is enclosed in small platinum tubes. Platinum is used as the standard for screening as it is the most efficient in eliminating the harmful, non-selective rays. 0·6 mm. platinum absorbs 99·9 per cent. of the harmful rays. Alternatively, equivalent thicknesses of other metals may be employed.

The technique of the two well-known centres, Paris and Stockholm, is as follows :—

Paris Method.—This method is carried out by one application, and six tubes of radium are usually employed.

Having dilated the cervical canal, a rubber tube (wall 1·5 mm. thick) containing three tubes of radium in tandem is passed into the uterine cavity. The innermost or fundal tube contains 6·66 mg. and the other two each contain 13·33 mg. As it is important that the entire length of the uterine cavity be irradiated, an additional tube may be required if the cavity is unduly long. In the vagina one tube (13·33 mg.) is placed in either lateral fornix and maintained in position by means of an applicator called a "colpostat," which is devised to hold the tubes in the sagittal plane. A third vaginal tube (containing 6·66 mg.) is placed in contact with the vaginal cervix.

The average dose given is about 8000 mg. hours. Radium treat-

ment is followed by the application of distance therapy, which may be given either by means of X-rays or a radium bomb. Depending on the extent of this, the dosage of radium employed locally may be reduced.

Stockholm Method.—This method is carried out by several short applications of a large quantity of radium. The second application is given one week after the first, and the third two weeks after the second. The screening always corresponds to 3 mm. lead or 1.5 mm. platinum. Special applicators are employed.

The uterine dose is given by means of a cylindrical applicator containing two, three or four tubes (about 40 mg.) in line according to the length of the uterine cavity.

For vaginal application various shapes of metal boxes are used and celluloid "sledges" are employed to maintain the applicators in position.

The total average uterine dose should not exceed 2600 mg. hours.

" " vaginal " " 4500 "

The total average dose is therefore about 7000 mg. hours.

Recently the standard method is occasionally modified. Two applications of radium have been recommended and a slightly smaller total dose given, followed by three exposures of deep X-ray. Variations from these standard techniques are many.

The Stockholm method of treatment is better tolerated by patients. The Paris method is much more convenient when dealing with numbers as in hospital practice. With the former, unless the follow-up system is efficient, patients are liable to go without completion of treatment. With the latter, if there is a limited supply of radium, there is less wastage as there is no difficulty in arranging that it be in full use all the time.

Surgical.—Radical removal of the uterus and the tubes and ovaries, with a dissecting extirpation of the surrounding tissue and a "cuff" of vagina, provides a chance of recovery, which may be assessed roughly at anything between 20 to 40 per cent. *if the cases are reasonably early ones.* The operation carried out by the abdominal route is the complete operation associated with the name of Wertheim (see p. 1117). Extended operation by the vaginal route, associated with the name of Schauta, has never been popular in this country. Good results have been published by those who have perfected this technique.

By some gynaecologists radium treatment, given before the complete hysterectomy operation, is claimed to clean up the growth and to cause shrinkage so that the operation becomes easier; but others object to the pre-operative use of radium because it tends to produce a fibrosis of the cellular tissue surrounding the cervix and thus to increase the difficulties of dissection.

Indications of Operability.—The degree of mobility of the uterus is the test applied to decide whether the condition is operable. If the

uterus is freely movable—indicating that the disease has not spread beyond the cervix to the vagina and the parametric tissue—the case may be dealt with by operation. If partly fixed by some vaginal extension and some infiltration of the connective tissue it may still be removed by dissection. If quite fixed by massive infiltration of the vagina, parametric tissue and, more especially, if the bladder and rectum are invaded, the case is inoperable.

It should be remembered that fixation of the womb may be due to the inflammatory exudate which is laid down in front of the cancerous growth, and a case which at first sight seems inoperable may be operable. A decision regarding this may present the greatest difficulty and may be determined with certainty only after laparotomy, a procedure quite justifiable to settle such an important matter.

The treatment to be followed where carcinoma of cervix and pregnancy coexist has been considered in the Obstetrical Section (p. 295). Here we would remark that the Wertheim operation is easier during pregnancy on account of the loose arrangement of the cellular tissue, but there is greater vascularity and hæmostasis is more difficult.

Sympathectomy should be reserved for severe pain in inoperable cases. Resection of the presacral nerves gives good results but should not be employed if there is marked cachexia. Narcosis from morphia or other drugs is obviously preferable if death is imminent.

Results of Treatment.—To summarise results of the methods of treatment is difficult as so many factors are not common to the different methods. For instance, radium treatment can be carried out in the vast majority of cases encountered, whereas operation is impracticable in a high percentage.

Again, it is not on the best results recorded for any particular method that we should argue. By radium treatment in early (stage 1) cases as high a cure rate (five years) as 86·6 per cent. is on record.¹ This represents only 5 per cent.—i.e. 15 out of a total of 288 cases treated. It is obviously unsafe to form conclusions from such a small number. Cures by radium treatment when all stages of the disease are included is estimated from the world's literature to be about 20 per cent. These results include those of highly specialised centres having a generous supply of radium and the best facilities for radium treatment. If these alone were considered the five-year cure rate is found to vary in the different centres; 23 per cent. up to 34 per cent. being recorded.

Results from operative treatment come mostly from centres where the surgeons are specially skilled in dealing with this disease. World-wide results of a similar standard could not be expected. Bonney, for instance, gives a five-year cure rate of 39 per cent. of operable cases. Operability rate being 63 per cent., the absolute cure rate is 24·6 per

¹ Radium Institute, London (*Brit. Med. Journ.*, 2nd April 1937).

cent. Dougal and Shaw give a similar figure of 38·3 per cent., but the operability rate is not noted.

In the larger centres where reasonable facilities and supplies of radium in adequate dosage are available, the results in the total cases treated are at least as good as after surgical measures, and so the choice of treatment at present leans towards the employment of radium.

As, both by surgical means and by radium, cures can be achieved if the case is obtained in the earliest stages of the disease, *it is clear that early recognition of the condition and arrangement for treatment is as important, if not more important, as the method of treatment.*

Deep X-ray therapy alone, without intracavitary radium or operation, has recently been claimed to give good results. While it is a method which, with possibilities of improvement in apparatus and technique, holds out great prospects of better results, the dependable records at present available do not indicate its superiority over either radium therapy or operation. It is, however, at present a useful adjunct to these methods.

CARCINOMA OF BODY

Carcinoma of the body of the uterus is much less frequent than cancer of the cervix, the relative frequency of the two sites being in the proportion of one to four or five.

Ætiology.—Child-bearing does not appear to have the pronounced influence it has in cancer of the cervix. In at least one out of four cases the patient is nulliparous. The age incidence is higher and more defined than in cancer of the cervix. Body cancer occurs mainly in women over fifty, and even at these ages is less common than the cervical growth. It is rarely encountered before the menopause.

The following is an analysis of the 208 cases treated in the Royal Samaritan Hospital, Glasgow (1928-37), referred to on page 959. The average age was fifty-six years. Sixteen per cent. were unmarried and 25 per cent. nulliparous. The parous subjects had on an average 4·8 pregnancies with viable children and 0·75 abortion. The average interval between the last pregnancy and discovery of the tumour was twenty-one years.

Pathology.—The cancer arises from the epithelium lining the glands or covering the surface of the corporeal mucous membrane. (1) The type, therefore, is ADENO-CARCINOMA, in which the malignant cells are arranged to form gland spaces (Fig. 383). The adenomatous appearance may persist throughout, and the malignant nature of the growth may only be confirmed by finding that extensions are invading the muscular wall of the uterus to an abnormal depth.

When the adenomatous arrangement is general the term "malignant adenoma" has been applied. In most cases the malignancy is abundantly apparent, for the cells proliferate so rapidly that they extend outwards as solid masses into the surrounding stroma or they fill up the gland spaces, which then become changed into solid blocks of cells. Where solid masses are thus produced the microscopic appearance may simulate that of a squamous-cell cancer. In many cases both the solid and the acinous arrangements are present in the same specimen. Fig. 383 shows how the solid masses are derived from the



FIG. 383.—Adeno-carcinoma of Body of Uterus.

same elements as go to form the adenomatous proliferation. Breaking down of the cells in the centre of the solid masses may produce an alveolar appearance. (2) A *squamous epithelioma* may occur in the corpus uteri. It is usually derived from an upward spread of a cervical cancer. It may, however, commence primarily in the body of the uterus, being preceded by a metaplasia of columnar to squamous epithelium. It has been suggested that excess of folliculin stimulates formation of squamous epithelium in the corpus uteri as this metaplasia is found in sections of the mucosa in hyperplastic conditions of the endometrium and myometrium. It is believed that it is from such transformed areas of epithelium that a squamous cancer may subsequently develop.

In the early stages there is a localised overgrowth of mucosa, which bulges into the uterine cavity (Fig. 384). At the same time, on its deeper aspect, the growth infiltrates and destroys the muscle. Spreading laterally the disease invades adjacent mucosa until the whole inner surface of the uterus is occupied by a soft, thick, pulpy lining. In some cases there are polypoidal or villous tufts projecting into and distending the uterine cavity. This, together with the progressive infiltration of the muscular wall, leads to an expansion of the uterus. In most cases the increase in size of the uterus is appreciable, and it may be considerable. Frequently, however, especially where a cancer develops in the atrophied uterus of an elderly virgin, the uterus may be quite small, although the disease has reached an advanced stage.

This uterus (Fig. 384) was removed from a patient fifty-nine years of age. She had been married thirty-six years, and had three pregnancies. The menopause occurred at forty years of age. She complained of irregular hæmorrhagic vaginal discharge for five years.

Curettage was performed and the curettings confirmed the diagnosis of cancer of the body of the uterus. Hysterectomy was carried out. The growth originates from the anterior wall which it has penetrated to some extent. (Represented diagrammatically in Fig. 379, 4.)

Lymphatic involvement is not, in most cases, an early or prominent feature. If the cancer grows low in the uterus the same glands are involved as in carcinoma cervicis—namely, the iliac and hypogastric. If high in the uterus the lumbar glands and, sometimes, the inguinal glands may be enlarged; the latter are involved *via* the lymphatics in the round ligament.

In later stages the disease spreads beyond the confines of the uterus into the *parametric tissue* and may invade *bladder* and *rectum*. The womb finally becomes fixed in the pelvis in a cancerous mass. Thereafter the disease may spread widely, involving tubes, ovaries, peritoneum and intestines, and produce an irregular tumour in the lower abdomen extending as high as the umbilicus. In such instances ascites is common.

Infection as a rule is a later phenomenon than in cervical cancer. The result is that septic discharge is not so early and the hæmorrhage



FIG. 384.—Adeno-carcinoma of Body of Uterus. (Actual size.)

not so great in amount. When sepsis occurs the progress of the disease is hastened, and the case is then apt to be complicated by salpingo-oöphoritis, cystitis, pyelo-nephritis and even by peritonitis.

Metastatic deposits may occur in the vagina, vulva, liver, lungs, bone and other tissues.

Symptomatology.—The three cardinal symptoms are the same as for carcinoma cervicis, though their order of development is somewhat different. They are: (1) Hæmorrhage, (2) Pain, (3) Fœtid Discharge, and appear in that order.

Hæmorrhage.—While this is usually the first symptom it is not necessarily an early stage in the life of the tumour. It may commence with a small amount of bleeding gradually increasing in degree, or there may be, to begin with, a sudden gush of blood followed by intermittent hæmorrhages. Bleeding may commence some months or years *after the menopause*. Corporeal cancer constitutes the cause in from 6 to 10 per cent. of all cases of postmenopausal bleeding. We have seen that in carcinoma of the cervix hæmorrhage following coitus is a frequent and significant symptom. In carcinoma of the body hæmorrhage may occur with excessive straining at stool due to compression of the uterus. Such hæmorrhage has to be distinguished from hæmorrhage from the bowel (hæmorrhoids); that is done by instructing the patient to place a small plug of gauze in the vagina before going to stool and afterwards to remove and inspect it.

Pain may be earlier than in cervical cancer, and it is probably dependent upon painful uterine spasm. Pain in the later stages is due to involvement of the parametric tissue, tubes, ovaries, and more particularly the peritoneum.

Fœtid Discharge may be late in developing. Eventually it is a source of great distress and, moreover, the constant loss of fluid by the vagina, added to the absorption of septic products, causes increasing anæmia and exhaustion.

Other symptoms depend on the occurrence of salpingo-oöphoritis, cystitis, pyelo-nephritis, peritonitis, or metastatic growths.

As already mentioned, corporeal cancer occurring as it does in the atrophied post-menopausal uterus, especially when the subject is a virgin, may be associated with a very small shrivelled uterus. In such a case an exact diagnosis is possible only by diagnostic curettage.

Usually, however, a large uterine body is felt. If there is considerable bulk of tumour or a pyometra, it feels softer and more globular. Later, bimanual examination reveals the uterus fixed by adhesions and surrounded by firm tumour tissue.

Anæmia, emaciation and cachexia may be prominent. On the other hand, the patient may for a long time apparently enjoy good health.

Differential Diagnosis.—The same questions arise here as in carcinoma cervicis. The age of maximum incidence in carcinoma

corporis is higher. It is very rare before the average age of the menopause, and this consideration generally rules out conditions (hæmorrhagic discharge) resulting from pregnancy, such as may be due to abortion or retained placental fragments.

Fibromyoma is recognised by the duration of the bleeding being too great to be due to malignancy, and by the discovery on examination of the solid tumour or tumours of the uterus. In fibromyomata hæmorrhage rarely starts after the menopause. In degenerating submucous fibroids, however, the symptoms and signs may exactly simulate carcinoma corporis, and an exploration of the uterine cavity is necessary to clear up the diagnosis. Corporeal cancer may be associated with fibromyoma. In the 208 cases cited on page 975 there were eighteen (8·7 per cent.) examples. On physical examination fibroids are, as a rule, easily diagnosed and are liable to be accepted as the cause of irregular bleeding. In a patient who is beyond the menopause, and especially if hæmorrhage first commenced after several years interval, the possibility (indeed probability) of cancer of the body of the uterus should be borne in mind and total hysterectomy should be performed.

Mucous polypus of the body of the uterus in patients beyond the menopause should be regarded with suspicion. Not only should such polypi be examined histologically, but curettings from the uterine cavity also should be examined. Occasionally the polypus has a simple structure, while evidence of malignancy may be found in its base or in the adjoining endometrium (*vide* p. 929).

Senile endometritis has to be differentiated. The age incidence and the general clinical features in the two conditions being similar, the microscopic examination of material scraped from the uterus alone can settle the matter. In both conditions the uterus may be enlarged or it may be atrophic.

Carcinoma cervicis is recognised by a growth on the vaginal portion of the cervix. A cancer concealed in the cervical canal can usually be recognised only after dilatation of the cervix and exploration of the body cavity and cervical canal. Cervical cancer is the commonest single cause of postmenopausal bleeding (at least 26 per cent. of the total, *vide* Table, p. 786).

Other causes of postmenopausal bleeding are: fibroids, senile endometritis, genital prolapse, cervical polypus, urethral caruncle, ovarian tumours and those conditions in which there is no uterine pathology or nothing more than some thickening of the endometrium with hyperplasia of the glands. This latter class is due to ovarian dyscrasia (p. 786).

Treatment.—While there is still difference of opinion regarding the relative merits of operation and radium therapy in operable cases of cancer of the cervix, it is generally conceded that in cancer of the body of the uterus, if operable, surgical treatment gives the better results.

The Stockholm school claims that radium treatment can compete with surgical treatment ; the Paris school does not make this claim.

Treatment by X-rays alone is not favoured, as may be judged from the following extract from a report by the Medical Research Council :—

“ External radiation appeared much less effective in cancer of the endocervix and corpus uteri, and curettage specimens removed after a dose as high as could be tolerated showed actively growing carcinoma cells. Cancer in these situations requires the local high intensity of dosage given only by intracavitary radium.”¹

The Cancer Commission appointed in America, after thorough investigation and inquiry, recommended hysterectomy with pre-operative radiation in cancer limited to the uterus, and radiotherapy in cancer extending beyond the wall of the organ.

Heyman's results from radium treatment show a 42·2 per cent. five years' cure. Treatment was mainly radiological, but combined with surgery in case of failure of the radiotherapy, the result being calculated on the total number examined. Radiological treatment alone (those operated on counting as died) gave a 33 per cent. cure.

The question of operability is not always decided by the extent or spread of the growth. A proportion of patients are very advanced in years. At seventy years of age the risk of operation is great and the patient's expectation of life in any case fairly short. A decision in favour of radium treatment would be justified even if locally the condition was operable. Many of the very elderly have chronic chest trouble and many are extremely stout. The choice of treatment should be made after full consideration of the conditions existing ; and remembering that it is the patient who is being treated, not the tumour.

The operation consists of complete hysterectomy (but not Wertheim's operation) with removal of tubes and ovaries, by the abdominal route. The abdominal is to be preferred to the vaginal route because it allows of better access and, therefore, of a freer and cleaner removal of the structures. Before the abdomen is opened the vagina is cleansed and disinfected and the vaginal cervix is closed by sutures to eliminate the risk of tumour and septic matter being expressed during the operation.

Care also must be taken to ensure that the uterus is not punctured by a volsella or any other instrument. It is most important that spill into raw areas or peritoneal cavity be avoided.

Palliative surgical measures have practically no place. Curettage other than for diagnosis is dangerous—*e.g.* an attempt to remove the tumour by the curette. There is grave risk of perforating the uterine wall.

The technique of treatment by radium and X-rays is the same as in cases of cancer of the cervix.

¹ Report by Medical Research Council (*Brit. Med. Journ.*, 30th Oct, 1937).

In the advanced stages the picture is very similar to that of cervical cancer, and sedatives should be administered generously.

SARCOMA OF UTERUS

Sarcoma of the uterus is a rare tumour. As compared with cancer of the uterus it is very rare indeed.

Ætiology.—This is unknown. Child-bearing would appear to have a predisposing influence, as most of the patients are parous. Sarcoma of the uterus is much commoner in the body than in the cervix. In

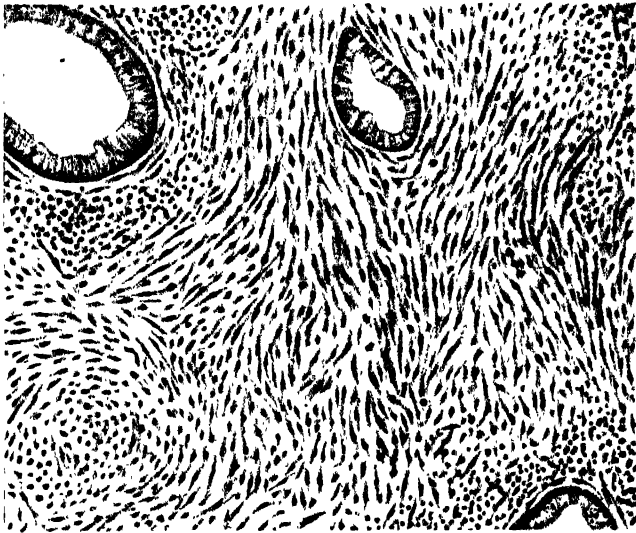


FIG. 385.—Spindle-celled Sarcoma of Uterus.

this respect it differs from carcinoma, which is much more common in the cervix.

Sarcoma may be spindle-celled (Fig. 385), round-celled, giant-celled or mixed-celled. In rare cases the tumour may be a malignant *leiomyoma*: here the cell elements are formed of smooth muscle fibres (p. 944). Two other rare subtypes are *perithelioma*, in which the malignant change commences in the tunica externa of the smaller blood or lymph vessels, and *endothelioma*, which commences in the endothelium of the vessels. Perithelioma and endothelioma are relatively benign tumours (*vide* p. 944).

Pathology.—Sarcoma usually originates in the centre of a *fibroid tumour* as a soft yellow or whitish nodule. This occurs in about 1 per cent. of cases. It is associated with rapid enlargement of the tumour (sometimes with accompanying tenderness), and this sign may arouse a suspicion of malignancy; as a rule, however, sarcoma is only recognised during a routine examination of fibroid tumours after removal.

Submucous polypoidal fibroids occasionally recur after removal, though microscopic examination may show no evidence of malignancy. After several such removals, the tumour may finally show sarcomatous changes. Such recurring tumours have been designated *recurrent fibroids*.

Sarcoma may originate in the connective tissue of the muscle layer of the wall or of the mucosa of cervix or body. *Sarcoma of the endometrium* is usually a round-celled tumour spreading diffusely over the inner surface of the uterus (Fig. 386). It may project in the form of polypoidal masses into the uterine cavity. In such cases inversion

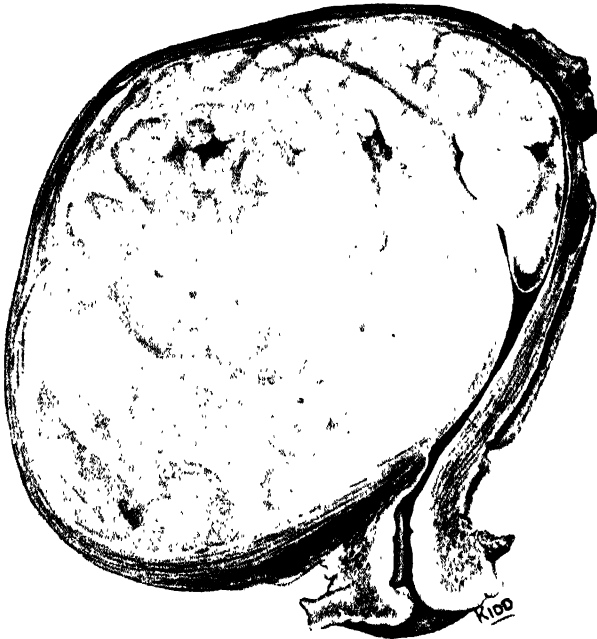


FIG. 386.—Sarcoma of Uterus—it has arisen from Endometrium.

of the uterus has sometimes occurred (*vide* p. 864). *Sarcoma of the muscular wall* growing independently of a fibroid tumour is a diffuse growth; the absence of capsule serves to distinguish it from the ordinary fibroid. *Sarcoma of the cervix* often assumes the form of a grape-like cluster of growths projecting into the vagina (*vide* p. 983).

Wherever they occur, sarcomata form soft masses of a yellow or yellowish-white colour. They are particularly liable to show multiple areas of hæmorrhage on a cut surface, and as frequently hyaline or cystic degenerations.

A tumour, if it spreads forward, may invade the bladder, whilst behind the rectum may be infiltrated. Secondary spread to the tubes, ovaries and peritoneum may occur. In such cases solid ovarian tumours develop and, as involvement of the peritoneum results, ascites is caused.

Distant metastases are common in sarcoma ; they are commoner than in cancer of the uterus.

In rare cases sarcoma of the uterus is found in association with carcinoma of the uterus.

Symptomatology.—Sarcoma of the cervix uteri (sarcoma cervicis botryoides) may occur *in children*. It is associated with a hæmorrhage from the vagina and pain which is usually an early symptom (p. 783).

Otherwise the age incidence of uterine sarcoma is forty-five to sixty. In elderly women sarcoma is difficult to distinguish from carcinoma. The symptoms are identical—vaginal hæmorrhage, discharge which becomes foul, and pain. The growth in sarcoma is usually more rapid, and the symptoms are correspondingly aggravated.

Ascites, abdominal pain and tenderness appear when ovarian and peritoneal involvement has occurred.

Sarcomatous degeneration in a fibroid causes, as a rule, enlargement of the tumour, with pain, and, in some cases, increase in the hæmorrhage.

Involvement of the bladder wall will give symptoms of cystitis. Fistula formation is rare in sarcoma.

As the result of the constant loss of blood and body fluids in the vaginal discharge, anæmia and gradually increasing exhaustion mark the later stages of the disease. In the end, in the majority of cases, death is due to these causes. In some instances it has been due to hæmorrhage.

There may be no evidence of the condition, and the malignancy may be revealed only after the removal of a fibroid. In other cases the tumour may be palpably soft and tender to the touch before removal. Ovarian secondary growths may be palpable on abdominal examination, and abdominal swelling the result of ascites may be recognised.

Bimanually the uterus may be felt to be enlarged or the seat of multiple growths. If the cervix is involved, the friable growth, which bleeds on being scraped with the finger, will closely simulate a cancer. In advanced cases the invasion of the surrounding structures produces a mass which envelops the uterus and which is adherent to the pelvic wall.

The microscopic examination of material removed by the curette or the knife provides the only certain pre-operative diagnosis.

DIFFERENTIAL DIAGNOSIS.—The chief conditions from which sarcoma uteri has to be distinguished are *fibromyoma* and *carcinoma*. When there are fibromyomata in the uterus a sudden enlargement with tenderness and hæmorrhage may denote malignancy. It may, however, only mean some simple degeneration. The question can therefore be settled only after removal. The physical signs and symptoms may closely simulate carcinoma. Early fixation is specially characteristic of sarcoma.

Curettage differentiates it from *other causes of hæmorrhage, e.g.*

metropathia hæmorrhagica, chronic metritis, polypi, retained placental fragments and chorionepithelioma.

Prognosis.—This is always grave. It is worst in a round-celled sarcoma of the endometrium, and best in sarcoma discovered in the centre of a fibroid, in perithelioma and in endothelioma.

Treatment.—The uterus and the appendages are extirpated completely by an abdominal operation. If this is not practicable (uterus fixed and metastases present) deep X-ray therapy should be carried out. Radium in the advanced cases may be utilised in conjunction with deep therapy, but the prognosis at this stage is bad.

CHORIONEPITHELIOMA

This rare malignant tumour of the uterus was the last to be identified.

Ætiology.—The tumour consists of tissue of a malignant nature derived from chorionic elements, hence, apart from exceptional cases (ectopic pregnancy), the UTERUS is its site of origin. *A preceding pregnancy is, therefore, the source of the condition.* The pregnancy may have ended in abortion or full-time labour, a fragment (possibly minute) of placenta having been left behind. In many cases (60 per cent. or more), however, it follows a hydatidiform mole, a portion of which has remained behind after expulsion of the mass of degenerated chorion (p. 300). Some moles are essentially malignant from the beginning: these differ from the simple mole in the excessive proliferation of trophoblast which they exhibit, and in the deeper erosion or even perforation of the uterine wall by the expanded villi. In such cases the fragment left behind is almost certainly destined to produce a chorionepithelioma. In other cases, however, the mole is structurally benign, and the malignant change occurs subsequently in the retained portion. Thus, symptoms may arise soon after the termination of the pregnancy or may be delayed for months or even a year or two.

Very rarely, the tumour may occur in the FALLOPIAN TUBE, following a tubal pregnancy: or theoretically in the OVARY, following an ovarian pregnancy.

Cases have been recorded where it has developed in the TESTICLE, and in the MEDIASTINUM as a primary tumour. In these unusual sites it has a teratomatous origin.

Pathology.—**NAKED-EYE APPEARANCES.**—The tumour occurs in the form of solid nodules of a deep purple or red colour mottled with pale areas. This appearance is due to the fact that the tumour elements are imbedded in blood-clot or surrounded by large blood-sacs, in which there may be a certain degree of circulation going on. The tumour masses may be single or multiple, projecting on the inner surface of the uterus, or situated within the muscular wall of the uterus, which they have reached by erosion or by migration along the blood-vessels. They

may also by direct extension or migration appear on the peritoneal surface (Fig. 387).

The malignant chorionic elements show the same tendency as the normal chorionic epithelium to *extend into and along the blood channels*. This fact explains the hæmorrhage, which forms a characteristic naked-eye and histological feature of the tumour. It also explains the mode of spread, which may occur to long distances along the ovarian and uterine veins into the broad ligaments and connective tissue of the



FIG. 387. —Chorionepithelioma of Uterus.

pelvis, and to the *vagina*, where secondary masses of tumour often are found.

Metastatic deposits occur, likewise, as the result of embolic deportation along the veins and occur especially in the lungs. These metastatic growths may give rise to very anomalous symptoms.

It is possible that the tendency to hæmorrhage, which is so characteristic of this type of tumour, may explain the very rare cases in which, the malignant masses becoming strangled by the bleeding which they provoke, spontaneous cure occurs.

Microscopic Appearances.—The tumour reproduces the general features of the normal chorionic epithelium. The chorionic villus is covered by two layers : (1) an inner, consisting of one or more strata of polyhedral cells—*Langhans' layer*, and (2) an outer, consisting of

irregular masses of multinucleated protoplasm—*Syncytial layer*. In chorionepithelioma these two elements occur in excessive amount and in irregular masses surrounded by blood in varying amount (Fig. 388).

Changes in Ovaries.—In chorionepithelioma, as in hydatidiform degeneration of the chorion, the ovaries (p. 302) often exhibit an interesting and peculiar change. This consists in the development, usually on



FIG. 388.—Chorionepithelioma.

both sides, of a number of cysts lined by lutein tissue and filled by clear fluid. A cluster of such cysts may lead to marked enlargement of the ovaries (Fig. 389). These are referred to as compound theca-lutein cysts (p. 993).

Symptomatology.—Persistent or repeated uterine HÆMORRHAGE following abortion, full-time labour, or hydatidiform mole is the chief symptom. It may be most profuse. Such bleeding might, of course, be due merely to the retention of a fragment of mole or placenta with no malign properties. Following hydatid mole it is, however, to be regarded with grave suspicion. Brews¹ in his investigation found that chorionepithelioma followed the expulsion of a hydatidiform mole in

¹ *Proc. Roy. Soc. Med.*, 1935, vol. xxviii., p. 1213 (Obst. and Gyn. Section, p. 69).

8.3 per cent. of the 70 cases of moles investigated. Curettage usually cures the simple cases referred to above. It leaves a case of chorion-epithelioma generally worse or only temporarily benefited.

Anæmia may be extreme as the result of the excessive blood loss. A characteristic lemon-yellow pallor is sometimes encountered, and is a valuable guide when it is difficult to estimate the amount of blood lost. Pain in the lower abdomen and small of the back may be present.

PULMONARY SYMPTOMS: Pain, blood-stained sputum and cough

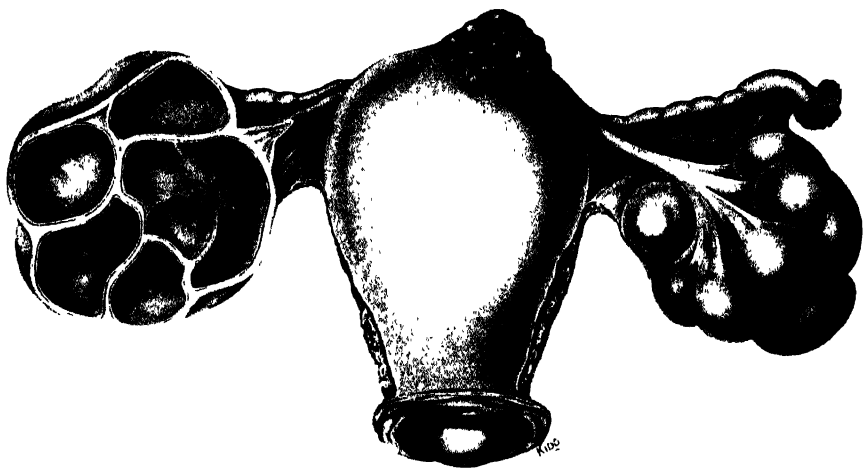


FIG. 389.—Uterus and Appendages from case of Chorionepithelioma. Note extension of growth through uterine fundus. Both ovaries are the seat of luteal cysts.

indicate an embolic deposit in the lungs, a common occurrence with this tumour.

In rare cases spontaneous cure, with disappearance of all symptoms, may occur.

BIMANUALLY the uterus, if there is bulk of tumour present, will be felt to be enlarged. In early cases the uterus may not be obviously enlarged. In advanced cases solid processes of tumour can be felt extending from the uterus to the wall of the pelvis and VAGINA, and in the latter site they bleed freely on examination.

Differential Diagnosis.—This at one time was difficult. The main difficulty arose in early cases, in which it was impossible, even after curettage, to tell whether the hæmorrhage was due merely to *retained products of pregnancy* of a simple nature or to *chorionepithelioma*. Microscopic examination of debris curetted might reveal the nature of the condition. By this means also such conditions as *subinvolution*, *metropathia*, *mucous polypi*, *fibromyoma*, *cancer* and *sarcoma* might possibly be excluded. To-day, however, we have a very exact method of diagnosis in the Aschheim-Zondek and Friedman tests. In chorionepithelioma these are positive in dilution (p. 168). If there is

any reason to suspect the possibility of chorionepithelioma, one or other of these tests should be made. We stress the importance of having this test carried out. *Sometimes the tumour is so embedded in the myometrium that the curette may fail to deliver a portion of tissue from which the histologist could make the correct diagnosis.* Furthermore, when this condition is suspected, as curettage is sometimes followed by such profuse hæmorrhage, there is a good deal to be said for having such tests carried out rather than performing curettage for histological examination.

Treatment.—If the case is operable, *complete removal of uterus and appendages* should be carried out. To prevent the detachment of the tumour masses which grow along the venous channels, a risk which may occur during manipulation, the ovarian and uterine vessels should be ligated as early as possible in the operation. Blood transfusion may be necessary before or during operation when, locally, the conditions are favourable for operation but the patient's general condition is bad. This is more likely to be the case with chorionepithelioma than with the other forms of malignant disease of the uterus.

In inoperable cases *X-rays* and *radium* may be employed. Sedatives for the pain are necessary.

The presence of metastatic deposits in the lungs or elsewhere renders the prognosis very grave. Nevertheless, if the pelvic disease can be removed this should be done, even under discouraging conditions, for it occasionally happens that the secondary deposits disappear after the removal of the parent growth. One possible explanation of this has already been mentioned.

CHAPTER L

DISEASES OF THE OVARIES AND BROAD LIGAMENTS

THESE may be considered under the following heads :—

- I. Abnormal sensitiveness and pain referred to the ovaries.
- II. Displacements of the ovaries.
- III. Inflammatory changes.
- IV. Morbid changes of the follicular system.
- V. Neoplasms of the ovary.
- VI. Broad ligament tumours.
- VII. Endometrioma of the ovary.

I. ABNORMAL SENSITIVENESS AND PAIN REFERRED TO THE OVARIES

The term “ovarian pain” is often applied in a diagnostic sense to pains and aches located in one or other iliac region, more commonly the left, but it is doubtful whether there is any actual justification for it except in a small minority of cases. The importance of this point lies in the fact that mistaken views as to the origin of the pain often lead to the sacrifice of harmless and even quite healthy ovaries. The ovary itself is insensitive to touch, but severe pressure causes a dull, sickening sensation just as in the testis, and increased tension within the ovary seems to cause aching pain. There is thus reason to believe that the pathological conditions which cause pain through involvement of the ovary *alone* are few.

In most cases of ovarian pathology the peritoneum, which does not cover the ovary but to which it is attached and with which it is in close contact, is also involved. This applies particularly to inflammatory conditions. Oöphoritis in the active phase is invariably associated with local peritonitis and usually with salpingitis, and in the chronic phase usually with adhesions, and it is the involvement of the sensitive peritoneum that causes the pain. Post-inflammatory sclerosis of the ovary, with or without the formation of follicular-retention cysts, is often supposed to be a cause of pain, and many ovaries have been removed on such a supposition. But these conditions are so often found during operations upon patients who have had no pain at all, that the justification for fixing the blame upon the ovaries themselves is open to question. On the other hand, the occasional occurrence of pain at the presumed time of ovulation (“Mittelschmerz”) in women with ovaries which are mobile but present thickening of the tunica

albuginea, suggests that the periodic congestive tension within the ovary may explain such pain, more especially in those cases in which the pain ceases abruptly, presumably when the tension is relieved by rupture of the follicle. It is generally said that the left ovary is more commonly the seat of pain than the right. The explanation offered is usually that, just as varicocele is commoner in association with the left testicle in the male, so there is a greater tendency to stasis and *congestion in the pampiniform plexus in the left broad ligament* in the female. The fact that the left ovarian vein joins the left renal vein at an angle and is said to be devoid of valves is adduced in explanation. The proximity of a frequently loaded pelvic colon with consequent pressure is at least as likely an explanation.

How then can we explain the pain which is so commonly "referred" to the ovaries in the absence of recognisable pathological conditions either of the ovaries themselves or of the adjacent tissues? The answer would appear to be either that the pain is merely the bodily reflection of a subconscious mental conflict, or else that the patient's threshold to pain has been so lowered by ill-health and chronic worry that functional changes in the ovary, which are normally painless, become associated with some degree of suffering. Marital unhappiness, abnormal sexual relations (*e.g. coitus interruptus*), masturbation, the fear of pregnancy, the bother and anxiety associated with contraceptive devices, the unsatisfied longing for a child—these are only some of the many things that may induce an "anxiety state" in a woman's mind, and, at the same time, tend to direct its physical manifestation to her ovaries. It is probable that in many cases a contributory cause may be found in chronic pelvic congestion and poor general health due to such conditions as chronic constipation, anæmia, overwork either mental or physical, too much standing about, and addiction to alcohol or other drugs.

It is important to keep these considerations in mind in the treatment of such "functional" ovarian pains. It should be regarded as an axiom that the removal of a sensitive ovary should rarely be considered in the absence of definite evidence of disease, for operation will not only mutilate the patient without permanently relieving her but will inevitably intensify the neurasthenic condition which is the real underlying cause of the symptoms. Treatment should rather be along medical and psychological lines, and directed in the first instance at any rate to the cure of the general nervous condition and of any of the contributory causes mentioned.

Recently success in the treatment of "ovarian dysmenorrhœa" by the denervation of the ovaries has been claimed by O'Donel Brown,¹ following the work of L'Hermitte and Dupont. This is effected by division of both infundibulo-pelvic ligaments. This method must be regarded as still on trial.

¹ O'Donel Brown, *Journ. Obst. and Gyn., Brit. Emp.*, 1939, vol. xlvii., 6.

II. DISPLACEMENTS OF THE OVARY

The Undescended Ovary is a rare condition, usually found in association with other evidence of imperfect development of the reproductive tract—double uterus, rudimentary horn, etc. It may be found at any level from the lower pole of the kidney downwards and, when in the pelvis, may be mistaken for a diseased tube owing to its elongated infantile shape. The condition of associated underdevelopment of the uterus may lead to pain in connection with the menstrual functions, and sterility.

Prolapse of the Ovary is often, but not always, associated with backward displacement of the uterus, in which case both ovaries are usually involved. Without uterine displacement, relaxation of the ovarian ligaments, the result of frequent pregnancies, and enlargement of the ovary leading to increased weight, may also produce prolapse. The prolapsed ovary or ovaries sink down into the pouch of Douglas and may eventually become more or less adherent in their abnormal position.

The symptoms are sometimes severe, more or less constant pain in the back and the pelvic region, especially when standing or walking, on straining during defæcation and during sexual intercourse (dyspareunia). For reasons already explained the pain is probably not due wholly to the ovaries themselves but rather to the general pelvic congestion. Moreover, patients in whom prolapse of the ovaries and backward displacement of the uterus are present are often in poor general health and more or less neurasthenic, and in them the threshold to pain is lowered.

Diagnosis.—On vaginal examination the prolapsed ovary lying low in the pouch of Douglas can be easily distinguished by its characteristic shape. It is usually tender when touched either *per vaginam* or *per rectum*. Pressure on the cervix by squeezing the ovary between the uterus and the rectum often provokes the characteristic pain.

Treatment.—If the uterus is displaced, the treatment must first be directed to rectifying the displacement and retaining the uterus in its normal position either by appropriate pessary treatment or by operative means. The replacement of the retroverted uterus raises a prolapsed ovary out of the pouch of Douglas. Palliative measures for the relief of pain, such as rest in bed, vaginal douching, and medicated vaginal tamponage, may give temporary relief, but in most cases the ovaries, especially if fixed and enlarged, will require to be restored to their normal position by shortening the ovarian ligaments or by correction of the displacement of the uterus if present, before permanent relief can be afforded.

Hernia of the Ovary may be congenital or acquired, the latter being the more common. In congenital cases the supposed ovary lying in the canal of Nück has sometimes been found on examination to be a testis or an ovo-testis in a partial hermaphrodite. In acquired hernia the ovary, either alone or together with the Fallopian tube, intestines

or omentum, may be found in the sac of an inguinal, femoral, or obturator hernia. An ovarian hernia is generally a source of pain and discomfort to the patient, especially during menstruation. If it cannot be reduced and if it interferes with the patient's ability to work, it should be treated by operative means which involve the removal of the ovary if there has been any strangulation; but, short of that, merely the replacement of the ovary, etc., and the closing of the hernial opening. If there is any reason to believe that the herniated organ is an ovo-testis it is probably better to remove it.

III. INFLAMMATORY CHANGES

Infection may reach the ovary by one or more of several routes. Infection ascending from the reproductive tract may reach it (*a*) by direct spread from the mouth of the uterine tube, or (*b*) by lymphatic spread from the placental site or a torn cervix, etc. Gonorrhœa probably most often spreads by the former route, puerperal infection by the latter or by both. (*c*) Infection may spread downwards from the abdomen, as, for example, in the case of appendicitis either acute or chronic affecting particularly the right ovary, and in abdominal tuberculosis. (*d*) Blood-borne infection explains oöphoritis arising in the course of acute general infections such as scarlet fever, typhoid, etc., or as a sequel to mumps, septic teeth and tonsils. Infections passing by routes (*a*) and (*c*) tend to affect mainly the surface of the ovary and produce *peri-oöphoritis*. Lymphatic and blood-borne infections involve the whole substance of the organ and produce *interstitial oöphoritis*.

In practically all cases the uterine tube and the adjacent pelvic peritoneum are also involved. Clinically the condition is one of pelvic peritonitis and salpingo-oöphoritis (see p. 1032), and it is only in regard to the pathological changes and sequels that inflammation of the ovary can be considered as a separate entity.

PERI-OOPHORITIS.—In the *acute phase* the ovary is swollen and covered with a sticky exudate which gums it to neighbouring structures such as the tube, broad ligament, and the bottom of the pouch of Douglas. Abscesses may occur by the infection penetrating into a corpus luteum or a superficial follicle. In the *chronic phase* the adhesions are dense and may completely conceal the organ. The tunica albuginea immediately below the surface epithelium tends to become sclerosed and as a late result atretic follicles are produced by failure to rupture through the toughened capsule. This is a common origin of the sclero-cystic ovary.

INTERSTITIAL OOPHORITIS.—In the *acute* form abscesses are common, either in the stroma, the follicles or corpora lutea. *Tubo-ovarian abscess* may also occur if an abscess becomes continuous with the cavity of a pyosalpinx. Luteal abscesses are the most common and may persist for long in a chronic condition without any associated pyrexia.

Chronic interstitial oöphoritis may be a sequel to an acute inflammation, but in many cases the infection is chronic from the outset. It is characterised by an increase in fibrous tissue throughout the whole ovary, due to organisation of inflammatory exudates. The fibrous tissue subsequently contracts, leaving an enlarged, hard and very wrinkled ovary. Many of the unripe follicles are strangled out of existence, while others become atretic; corpora albicantia are numerous. In extreme cases the ovary becomes practically a small mass of fibrous tissue. The condition is similar, except for its larger size, to that of the senile ovary. The term "*cirrhotic ovary*" is sometimes applied to it. *Tuberculous Ovary*, vide p. 880.

IV. MORBID CHANGES OF THE FOLLICULAR SYSTEM

Follicular Cysts.—**SCLERO-CYSTIC OVARY.**—Under this heading may be classed various changes which in effect are similar to the late results of chronic oöphoritis just described. A *sclero-cystic condition of the ovary*, for example, appears to result in some cases from prolonged or frequently repeated circulatory changes, such as may be associated with unsatisfied sexual excitement, masturbation, *coitus interruptus*, or habitual contraceptive douching after coitus. Similar changes are frequently found in the ovaries in cases of uterine fibroids. Whatever be the precise nature of their origin, these changes cannot, in many cases, be attributed to previous inflammation. The common origin of a sclero-cystic ovary as the result of peri-oöphoritis has been explained above.

Another common cause of a sclero-cystic type of ovary, or "small cystic ovary," as it used to be called, is the spontaneous failure of some ripening Graafian follicles to rupture, either as a result of death of the contained ovum or of failure of the gonadotropic hormonal stimulus to ovulation. As a consequence the atretic follicles may become converted into little retention cysts. When such a follicular retention cyst attains any size (*e.g.* that of a golf-ball) the term "hydrops folliculi" is sometimes applied, and when, as rarely happens, several such cysts coexist, the condition has been called "Rokitanski's tumour." A single follicular cyst must be distinguished from a simple serous cyst, which is a neoplasm. The former contains relics of the granulosa layer in its lining; the latter is lined by a ciliated epithelium.

CORPUS LUTEUM CYSTS.—If the ovum in a follicle dies early a follicular cyst may result, as stated above. If it dies at a later stage of maturation of the follicle the granulosa cells may undergo luteinisation, and the cells of the theca interna develop into theca-lutein cells. The cyst so formed is lined by luteinised granulosa cells or by luteinised theca cells or by both, and is called a *granulosa-lutein* or a *theca-lutein cyst*, according to the predominant character of the lining. Ordinarily such cysts are small and unilocular, and they may be found along

with follicular cysts in a sclero-cystic ovary. Occasionally they are compound multilocular cysts of some size, and the special interest of these latter is their association with hydatidiform mole and chorionepithelioma. They are now regarded as the result of the excess of the anterior-pituitary-like hormones or prolans present in these conditions. They undergo spontaneous retrogression when the mole is removed (p. 302).

Small cysts may also form in corpora lutea which have developed normally after ovulation. These may be found in early pregnancy, but more often in abnormal pregnancies such as tubal pregnancy, missed abortion, or hydatidiform mole.

HÆMATOMATA may form either in a ripening follicle or in a corpus luteum as the result of inflammation or any form of congestion. W. Shaw¹ distinguishes between (a) theca-lutein tarry cysts which arise from bleeding into atretic follicles; (b) granulosa-lutein tarry cysts which arise from bleeding into a granulosa-lutein cyst; and (c) corpus luteum tarry cysts due to hæmorrhage into a developed corpus luteum. The clinical interest of such hæmatomata is twofold. In the first place, hæmorrhage into a Graafian follicle or corpus luteum may occasionally be followed by rupture and profuse bleeding into the peritoneal cavity, producing a condition closely simulating a ruptured tubal pregnancy. In the second place, the "tarry" cysts, so-called from the appearance of the old altered blood in them, closely resemble endometriomatous cysts and may be confused with them unless careful microscopic examination is made (p. 1015).

CLINICAL FEATURES.—Follicular cysts are often seen at operation in patients who have had no symptoms referable to the ovary. On the other hand they may be associated with profuse functional bleeding—*metropathia hæmorrhagica*—both the ovarian and the endometrial changes being due to an underlying hormonal imbalance (p. 788).

In sclero-cystic disease the patient usually complains of premenstrual pain referred to the ovarian region, and sometimes of pain at the time of supposed ovulation—i.e. about the middle of the intermenstrual interval. Dyspareunia is a common symptom. Menorrhagia may also occur, and is probably of functional origin unless the ovarian disease is associated with uterine fibroids.

The cirrhotic type of ovary is associated with more severe premenstrual pain, and with menorrhagia which is usually due to an associated fibrosis of the uterus resulting from the same inflammatory attack as produced the ovarian changes. Pain is also a prominent symptom in hæmatoma of the ovary.

TREATMENT.—General medical treatment is not helpful, but there is growing evidence that in cases associated with functional bleeding the latter symptom may be controlled, and follicular cysts caused to retrogress, under appropriate treatment by sex hormones. Curettage

¹ W. Shaw, *Journ. Obst. and Gyn., Brit. Emp.*, vol. xxxiv., No. 2.

(endometrial biopsy) is a necessary part of the diagnosis of such cases, and may occasionally in itself cure the condition (p. 790).

Operative treatment of the ovaries usually means their removal. Where the pain is referred to one ovary and it is removed, the relief, if any, is usually shortlived, and a year or eighteen months afterwards the pain is as severe on the other side. Puncture of the cysts and excision of the cystic portions of sclero-cystic ovaries give merely temporary relief, and the same applies to the operation of *decortication* in which a portion of the sclerosed capsule is removed to relieve the tension. The main virtue of such operations is that they conserve function for some time longer, even if they only postpone more radical procedures.

The use of ovarian grafts to supply oestrogenic hormone in women whose ovaries have been removed has now given place to the oral administration of synthetic oestrogens.

V. NEOPLASMS OF THE OVARY

Accurate classification of neoplasms of the ovary is, in the present state of our knowledge, an impossible task, for uncertainty still attaches not only to the aetiology of many tumours but also to the origin of the normal tissues of the ovary. Much support has been accorded to the views of Goodall, who stresses the importance of the germinal epithelial covering of the ovary and downgrowths therefrom in the production of tumour formation. The epithelium of the Graafian follicles in the ovarian cortex is likewise held to be derived from downgrowths in early foetal life.

In opposition to this view, Fischel, in 1930, stated his conviction that the germinal epithelium remains merely as a covering layer, and that both the connective tissue stroma of the ovary and the cells of the Graafian follicle are derived from the same source, namely, the mesenchymal tissue of the developing gonad. Schiller of Vienna now accepts Fischel's view, which, if true, would make the determination of certain tumours an easier problem.

In the early weeks of development there are present in the gonad cords and tubules which run from cortex to hilum. If the gonad is to become male, the tubules form the seminiferous tubules, vasa recta and rete testis, the latter leading to the vasa efferentia and to the excretory duct, the vas deferens (Wolffian duct). If the gonad is to become female, the cells of the cords form the cells of the Graafian follicles, medullary rays and rete ovarii. If remnants of the two latter persist, there will be present in the mature organ embryonic cells which may be the origin of tumour formation in later life.

Neoplasms, therefore, *may* arise from embryonic persistent cells, from the germinal epithelial tissue and from the stromal tissue of the ovary. They do not arise from the mature Graafian follicle.

CLASSIFICATION OF OVARIAN TUMOURS

A.—Tumours of Intrinsic Origin (i.e. Primary)**1. EPITHELIAL TUMOURS****(a) Benign :**

- (1) Simple serous cystoma.
- (2) Pseudomucinous cyst-adenoma.
- (3) Papillomatous serous cyst-adenoma.
- (4) Surface papilloma.

(b) Malignant :

- (1) Adeno-carcinoma (solid or cystic).
- (2) Pseudomucinous cyst-adenoma with carcinomatous change.
- (3) Papillary adeno-carcinoma (malignant papillomatous cyst).
- (4) Dysgerminoma.

2. CONNECTIVE TISSUE TUMOURS**(a) Benign :**

- (1) Fibroma.
- (2) Fibromyoma.

(b) Malignant :

- (1) Sarcoma.
- (2) Endothelioma (perithelioma).

3. TERATOMATA (EMBRYOMATA)**(a) Benign :**

- (1) Dermoid cyst.
- (2) Struma ovarii.

(b) Malignant :

- (1) Malignant dermoid cyst (squamous epithelioma).
- (2) Solid malignant teratoma.

4. FUNCTIONING OVARIAN TUMOURS (BENIGN OR MALIGNANT)

- (1) Granulosa-cell tumour (feminising tumour).
- (2) Brenner tumour (feminising tumour).
- (3) Arrhenoblastoma (masculinising tumour).

B.—Tumours of Extrinsic Origin**1. INVASION FROM GENTAL****TRACT :—**

- (a) Carcinoma.
- (b) Sarcoma.
- (c) Chorionepithelioma.

2. METASTATIC SPREAD :—

Secondary to carcinoma of breast, stomach and colon, including Krukenberg tumour, generally secondary to gastric carcinoma.

Broad Ligament Tumours

- (1) Fimbrial cyst.
- (2) Cyst of parovarium or epoöphoron.
- (3) Cyst of paroöphoron.
- (4) Cyst of Kobelt tubules.
- (5) Cyst of hydatid of Morgagni.

Frequency of Types of Neoplasms.—Epithelial tumours are vastly more common than those of connective tissue origin, and of the former the multilocular pseudomucinous cyst-adenoma is much the commonest. The relative frequency of benign to malignant tumours is of great clinical importance, and it is necessary to emphasise how misleading is the view once held that malignant tumours are rather uncommon. It can be stated without hesitation that *at least 25 per cent. of all ovarian neoplasms will prove to be malignant* if histological examination be made of different areas in every instance. In women over forty years of age the percentage of malignant tumour is even higher.

In a series of 794 cases studied in the Gynæcological Laboratory of Edinburgh University, the malignant cases formed 36·4 per cent. of the total. This figure is possibly unduly high to be a true representation of the frequency of malignancy in ovarian tumours as a whole.

Total Number : 794 Cases

Benign	505 (63·6 per cent.)		
Malignant	289 (36·4 „)		
<i>Benign Tumours</i>		<i>Malignant Tumours</i>	
Pseudomucinous cyst-adenoma	222	Adeno-carcinoma	219
Dermoid cysts	88	Papillary adeno-carcinoma	48
Simple serous cystoma	78	Krukenberg	9
Papillary serous cyst-adenoma	59	Sarcoma	8
Fibroma	40	Malignant dermoid cyst	2
Granulosa	9	Malignant teratoma	2
Brenner	7	Dysgerminoma	1
Struma ovarii	2		
<hr/>		<hr/>	
505		289	

Before discussing the individual tumours it is advisable to draw attention to some general features of pathological importance.

Ovarian tumours may be entirely cystic, entirely solid, or partially of both forms. They may be unilateral or bilateral, some varieties showing a preference in this regard. They may be obviously benign or obviously malignant, but in many the distinction is possible only by histological scrutiny. Most benign tumours are cystic and mobile; malignant ones are mobile at the outset, but often become fixed. Primary malignant tumours *may* be unilateral, but secondary growths are usually bilateral. With some neoplasms ascites is associated, but *ascites does not necessarily denote malignancy*. To emphasise this point the following table is presented :—

Free fluid may be found with :

Benign Tumours :

- (1) Fibroma.
- (2) Innocent papillomatous cyst.
- (3) Rupture of cyst.
- (4) Pseudomyxoma peritonei.
- (5) Torsion of cyst pedicle—here the fluid is slight in amount.

Malignant Tumours :

- (1) Malignant solid, smooth tumour, even though mobile.
- (2) Malignant papillomatous cyst.
- (3) Malignant tumour which has erupted through the capsule.
- (4) Nearly all secondary malignant tumours.

Free fluid may be absent in malignant cases :

- (1) When a malignant cyst is mobile and with an unbroken surface.
- (2) When a malignant tumour (solid or cystic) is in the pelvis, either fixed or free.

A.—TUMOURS OF INTRINSIC ORIGIN**1. EPITHELIAL TUMOURS****(a) BENIGN EPITHELIAL TUMOURS**

Simple Serous Cystoma.—This cyst is usually unilocular and unilateral, and rarely grows to a large size. It has a smooth surface, a thin wall and is translucent in appearance : its content is clear, straw-



FIG. 390.—Simple Serous Cysts. Unilocular in type.

coloured, serous fluid. The cyst has a wall of fibrous tissue lined by a single layer of cuboidal or columnar epithelium which may be ciliated in some parts. One or two small papillomata may be found internally : such papillomata have a simple structure and are never malignant. If rupture of the cyst wall occurs no harm results in the peritoneal cavity from the escape of the fluid content.

Pseudomucinous Cyst-adenoma.—This, the commonest of all ovarian tumours, is generally unilateral, and may grow to such a size that the whole abdominal cavity is filled. With very few exceptions the cyst is multilocular, a few large loculi being associated with many of smaller size. Occasionally the tumour consists of an enormous number of small loculi of almost equal size—the *microcystic tumour*,

a type which, at operation, may suggest malignancy by its compactness of structure.

The surface of the cyst is smooth and lobulated, its configuration and consistence depending upon the size and number of the loculi enclosed. It has a glistening appearance and pearly-blue colour, and is initially covered with germinal epithelium, but this covering is lost as the tumour enlarges. Peritoneum does not cover the tumour. Each loculus has a fibrous wall lined by tall columnar epithelial cells, the small nuclei being basal in situation, and goblet cells are common. The cells secrete a jelly-like pseudomucin into the loculi of the cyst, which tends to become thinner in the largest loculi. On clinical examination



FIG. 391.—Multilocular Pseudomucinous Cyst of Ovary. Benign Tumour.

part of the tumour may feel markedly cystic, while a semi-solid consistence may pertain in other areas. The distension of the large loculi leads to flattening of the lining epithelium and to thinning of the cyst wall; in spite of this, however, rupture of the cyst is not a common occurrence. Small warty growths are sometimes found in these tumours; they are seldom profuse and generally benign in nature.

In its growth the tumour rises up out of the pelvis and draws its attachments out into a pedicle, which may be some inches in length. *The pedicle consists of* the ovarian ligament, the infundibulo-pelvic ligament, Fallopian tube and the upper part of the broad ligament. The main blood supply comes from the ovarian artery.

The rate of growth varies greatly; but whenever a cyst shows rapid enlargement, especially if it is known to have been almost stationary in size for a period of time, the possibility of malignancy should be remembered. Malignant areas may develop in these essentially benign tumours, and such areas often take on a semi-

solid appearance. It has been stated that about 8 per cent. of these tumours show malignancy ; but over forty years of age the percentage is higher.

Pseudomyxoma Ovarii is a variety of pseudomucinous cyst in which the secretory activity of the cells is extremely great, and the wall of the cyst thin. The pseudomucinous content is even thicker than in the common type, and if rupture of the wall occurs the contents spread over the abdominal cavity and detached secreting cells become implanted in the peritoneum—a condition termed *pseudomyxoma*

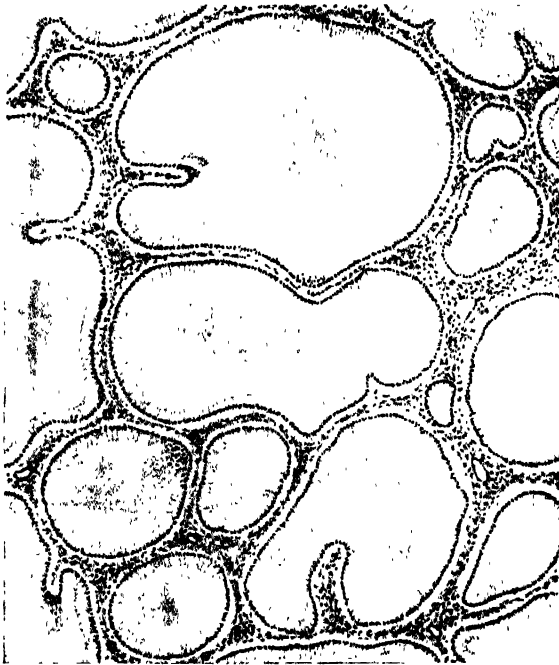


FIG. 392.—Microscopic appearance of Pseudomucinous Cyst-adenoma of Ovary.

peritonei. The abdominal distension increases, the intestines become matted together and the patient steadily, but slowly, loses health and strength. In course of time malignant change may ensue ; but even in its absence the patient generally succumbs in a year or two, often after repeated opening of the abdomen to evacuate the jelly-like material.

Papillomatous Serosus Cyst-adenoma.—These cysts have three main characteristics—they show a profuse growth of papillomata ; they are commonly bilateral ; they have a tendency towards malignancy. Generally unilocular, the cyst is seldom large and often grows between the layers of the broad ligament. It is, therefore, frequently fixed in the pelvic cavity and devoid of a pedicle. The

fibrous wall is lined by columnar epithelium which secretes a thin serous fluid into the cavity and presents an abundant growth of papillomatous structures. In many instances papillomata are found both internally and externally, but occasionally they are altogether on the outer surface.

The papillomata may appear as flattened, warty growths in isolation or in masses of varying size, but they are also found as more delicate villous processes with the appearance of very active growth. They may be so profuse that the cyst is packed with them, little serous fluid being present in the cavity.

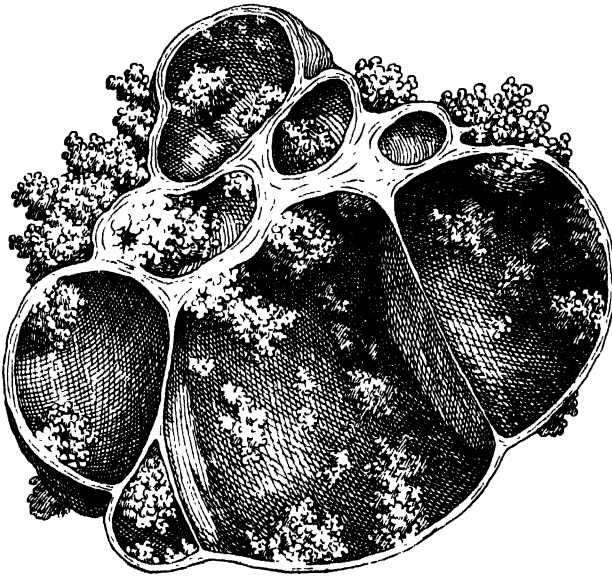


FIG. 393.—Section through Papillomatous Cyst of Ovary.

Examination shows the papillomata to have a core of connective tissue covered by columnar epithelium, usually in single layer, on a basement membrane; but even in innocent cysts the epithelium may show two or three layers of cells, uniform both in size and in their nuclei. This heaping-up of cells is more commonly seen in the feathery type which contains little stroma: the flatter, warty type shows a less active epithelial layer covering an abundant stroma.

Cysts with external papillæ are often associated with ascites and secondary nodules in the peritoneal cavity. Such a condition may be present even though the cysts are benign, and removal of the primary cysts may be followed by regression of the peritoneal nodules.

Owing to the tendency towards malignancy in these tumours, it is essential that sections should be histologically examined from several areas, for it is often impossible to determine the true nature from naked-

eye inspection alone. A definite proportion show carcinomatous change in one or more areas, while the bulk of the tumour is benign. The prognosis following surgical removal is, on the whole, good if malignancy is limited to one or two areas inside the cyst cavity.

SURFACE PAPILLOMA.—Occasionally an ovary shows on its surface a small papillomatous growth, attached perhaps by a very short pedicle, and innocent in appearance. There are no adhesions and free fluid is absent. The structure is that of a simple papilloma, and, as it is quite small, diagnosis prior to operation is impossible.



FIG. 394.—Benign Papillomatous Cyst of Ovary. Photomicrograph. Note the simple appearance of the epithelium covering the papillomata, with fibro-cellular stroma.

(b) MALIGNANT EPITHELIAL TUMOURS

These may be primary or secondary growths, the primary being much more commonly met with. Primary tumours have their highest age incidence in the period forty-five to sixty years, but their occurrence in young women is by no means rare. The primary growths are often unilateral, but a bilateral condition is the rule in secondary growths. Some ovarian neoplasms which are originally benign develop malignancy at a later date. For this reason all tumours should be opened at once after removal so that inspection may be made for carcinomatous areas; if such be found, immediate removal of the pelvic organs *in toto* will usually prove to be the safest procedure. Greyish, semi-solid areas are almost always malignant, and while benign tumours seldom show necrosis, malignant cases do so frequently.

Primary Adeno-carcinoma.—These tumours may be solid, semi-solid or cystic.

The solid growths are firm and pedunculated, with a smooth lobulated surface. On section the tumour has a fairly homogeneous appearance, often with necrotic areas and degenerative cystic spaces. The other ovary may be involved, though it is frequently of lesser size; indeed, it may not appear at operation to be affected at all. Even with a mobile tumour ascites may be present. Later the growth erupts through the outer surface with resulting fixation and involvement of bowel and peritoneum. Metastases to other organs are common, especially to the pleura and liver. It should be pointed out



FIG. 395.—Primary Malignant Solid Ovarian Tumour, Adeno-carcinoma in Type. Ascites was present. Other ovary was benign and contained follicular cysts. Removed from girl, aged thirteen years.

that *malignant growths accompanied by ascites are often associated with fluid in the pleural cavities*. This should be remembered when surgical intervention is under consideration. Spread by the lymphatics explains the involvement of liver, pleura and other organs in the body. The occurrence of bilateral primary growths without other involvement of the abdominal contents probably signifies an independent malignant development in each ovary.

The cystic and semi-solid tumours are common. While the wall of the tumour remains intact there may be no clinical features pointing to the serious nature of the growth. Even tenderness on palpation may be absent. Once a break in the capsule occurs, spread rapidly ensues with the development of ascites. Pain and tenderness are then apparent. These tumours frequently show necrotic areas, often bloodstained, and a marked degree of friability.

Histologically the tumours show typical adeno-carcinomatous tissue, little stroma intervening between the masses of malignant cells. Frequently a papillary carcinomatous picture is also presented.



FIG. 396.—Malignant Tumour of Ovary. Semi-solid tumour. Adeno-carcinoma in the main mass. The strip of tissue with definite loculi was of benign pseudomucinous type. No adhesions and no ascites in this case. Outer surface of tumour was smooth and unbroken.

Malignant Papillomatous Cysts.—Almost always bilateral, these tumours resemble the benign type in general appearance, but there is often a solidity about the luxuriant papillomatous projections that at once suggests carcinoma. Both external and internal papillomata may be present, and sometimes the appearance suggests a bursting open of the cystic growth. Secondary peritoneal nodules and ascites are the rule. Primary cysts are firmly fixed in the pelvis and lower abdomen.

Histologically the warty growths show many layers of irregular columnar cells with varying nuclei. Mitotic figures are numerous. The cells can be seen invading deeply the stroma of the papillæ, which are much denser in structure than in the benign cases. There are,

however, some cysts of this type in which the diagnosis of malignancy is extremely difficult to determine, and much experience in ovarian pathology is required before a decision can be arrived at.

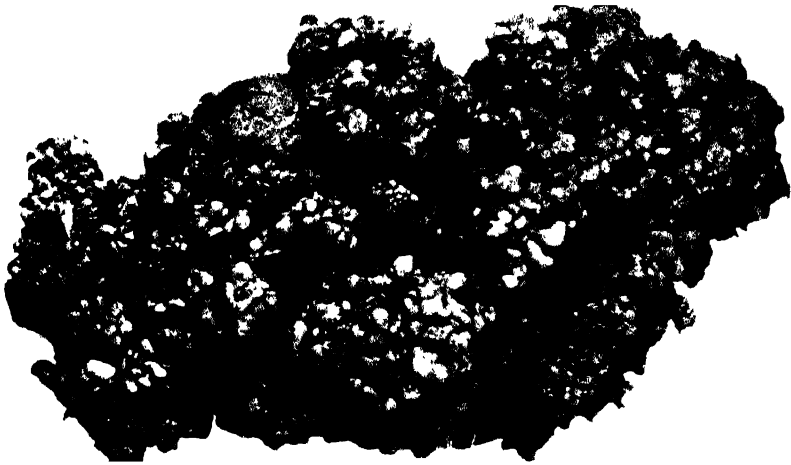


FIG. 397. --Malignant Papillomatous Ovarian Tumour, which was associated with much ascites.

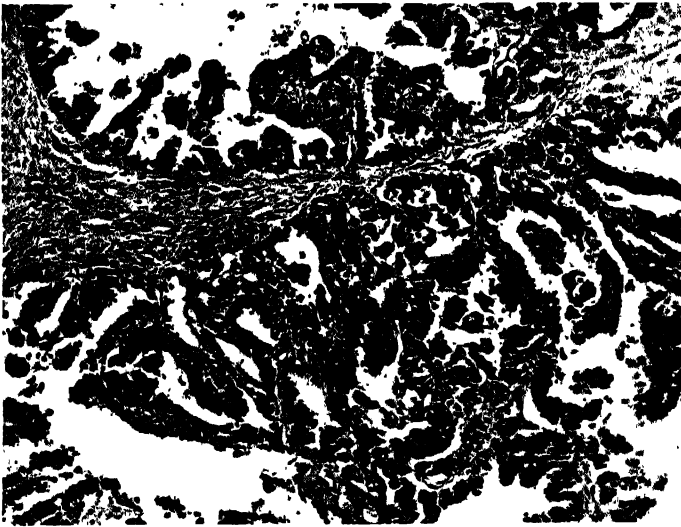


FIG. 398. --Malignant Papillomatous Cyst of Ovary., Photomicrograph.
Note the active, irregular appearance of the epithelium.

Dysgerminoma.—This rare form of solid tumour is found mainly in adolescent girls and young women. It is not infrequently bilateral. When unilateral, the other ovary and uterus may be normal and function properly—pregnancy has been reported in association with the neoplasm—or the internal and external genitalia may show definite

hypoplasia. Although probably carcinomatous in nature, the tumour is in most cases clinically benign, and its removal may be followed by full genital development. Hitherto hormonal activity has been denied to the tumour, but recent reports suggest that a masculinising effect may be produced in the adolescent. Interest attaches to the fact that when dysgerminoma of the gonad occurs in the male it is generally highly malignant and arises at a later period of life than in the female.

The solid tumour has a greyish-white appearance; histologically it is composed of masses of large epithelioid cells with large nuclei, between which lie large numbers of lymphocytes. Fibrous bands usually separate the cell masses. It is generally mobile and not accompanied by ascites.

2. CONNECTIVE TISSUE TUMOURS

In this group are placed fibromata and sarcomata, tumours much less frequent than those of epithelial origin. In our series fibromata accounted for about 8 per cent. of all the benign neoplasms, and sarcomata for less than 3 per cent. of the malignant cases (*vide* Table, p. 997).

(a) BENIGN TUMOURS

Fibroma.—An encapsulated form occupying only part of the ovarian tissue is occasionally met with, but the commoner type is the diffuse fibroma displacing entirely all ovarian structure. It is a solid fibrous

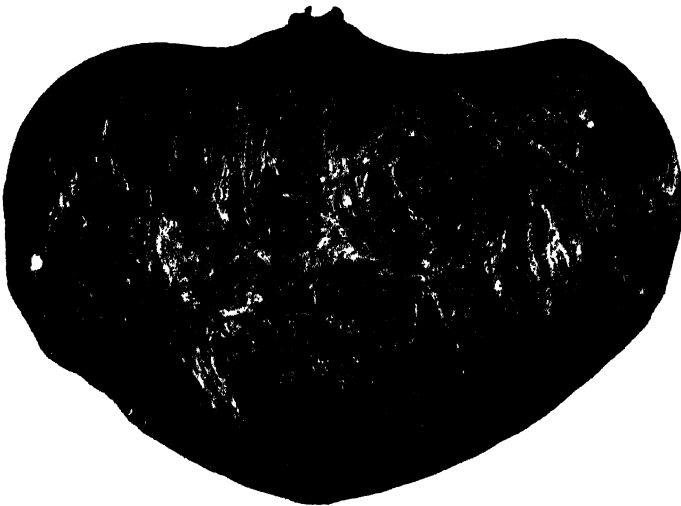


FIG. 399.—Fibroma of Ovary, infiltrated with Blood, the Result of Acute Torsion of Pedicle.

growth, usually unilateral, and although it reaches a large size it tends to retain the general shape and lobulated surface of the ovary. The tumour is pedunculated and liable to torsion with resultant

extravasation of blood throughout its substance. Cavity formation, the result of degeneration, is common, and when marked the tumour may appear clinically cystic. Areas of hyaline change are very common. *Of clinical importance is the fact that about 20 per cent. of fibromata are associated with ascites*; this does not denote malignancy. There is no evidence of peritoneal reaction nor are adhesions usually present. Fluid in the pleural sacs is an occasional finding.

Microscopically the tumour consists of dense fibrous tissue, dispersed throughout which may be areas of large spindle cells with well-staining nuclei. The latter are especially evident in actively growing fibromata and may raise a suspicion of sarcomatous change, the distinction between the two being a matter of some difficulty. The regularity of size, shape and staining of the nuclei, few mitotic figures and an absence of large multinucleated cells will denote an innocent growth.

Small surface fibromata and fibromyomata are also occasionally found in the ovary.

(b) MALIGNANT TUMOURS

Sarcoma.—(Of the malignant tumours in our series, sarcomata formed only about 3 per cent. of the total. They occur mainly about the time of puberty and after the menopause, and in the young patient



FIG. 400.—Sarcoma of Ovary. Structure was homogeneous and infiltrated in places with blood. The structure was quite different from that of fibroma (Fig. 399).

they grow with great rapidity and are accompanied by ascites in more than half the cases.

Like fibromata they often keep an ovoid shape with a lobulated surface and remain free of adhesions for a considerable time. Both ovaries are usually involved. Sarcomata are pale homogeneous growths of soft solid consistence, hæmorrhagic areas and degenerative change being common. The tumour may be of the round, spindle-celled, or mixed types, showing the usual histological features. Reference has

been made to the importance of distinguishing the spindle-celled type from an actively growing fibroma.

Spread in the abdomen and to other regions—*e.g.* lungs—occurs early with the round-celled type, the form generally found in young girls and in which the prognosis is extremely grave.

ENDOTHELIOMA and **PERITHELIOMA** are varieties of sarcoma, though the degree of malignancy is not as a rule so marked. The tumours arise from the endothelial lining of lymphatic channels and from the perivascular lymphatics.

3. TERATOMATA (EMBRYOMATA)

(a) BENIGN

TERATOMATA are found in the ovary in two forms. The common form is known as a dermoid cyst, which rarely becomes malignant; the other is a semi-solid tumour which is essentially a malignant growth from the outset.

The origin of teratomatous neoplasms is still unknown, and none of the various theories propounded yields a satisfactory explanation.

Dermoid Cyst (Cystic Teratoma).—This tumour may arise at any

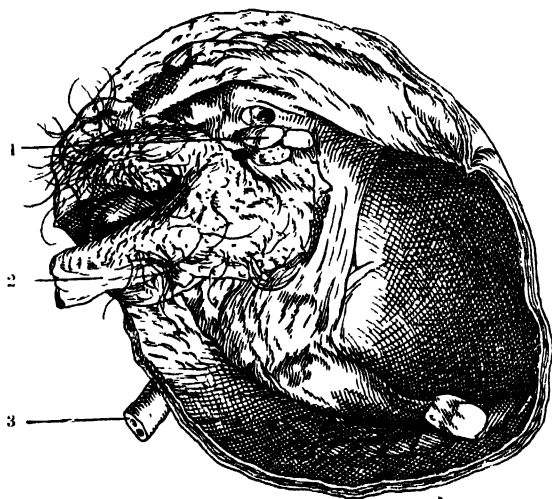


FIG. 401.—Dermoid Cyst of Ovary:

1. Teeth. 2. Hair. 3. Pedicle.

age—we have found one in a still-born foetus. Commonly unilateral, it forms a rounded pedunculated cystic growth, whitish in colour and with a smooth surface. Of all the ovarian tumours it is perhaps the most liable to torsion of its pedicle, and it is prone to become adherent. A dermoid cyst may form one loculus of a multilocular pseudo-mucinous cyst of considerable size. It is a distension cyst, the increase in size being due to

the retention of sebaceous secretion poured out from the glands of its wall. There is no progressive proliferation of epithelial tissue as in other types. The tumour is generally unilocular; rarely does it show more than two or three loculi.

The term “dermoid” is incorrect, for the cyst may contain structures not only of ectodermal origin but of all three layers of the embryonic phase.

The wall of the cyst is of fibrous tissue, and its cavity is distended

with a greyish-white sebaceous matter in which hair is imbedded, either in scanty or in large quantity. Occasionally the sebaceous



FIG. 402.—Section through Wall of Dermoid Cyst. The inner lining consisted of squamous epithelium.
A. Sebaceous Glands.



FIG. 403.—Section through Wall of Dermoid Cyst showing Squamous Epithelioma.

material is present in the form of scores of little waxy balls with hair in the centre. The contents are fluid at body temperature, but after removal they become pultaceous in consistence.

Part of the cyst wall is lined by squamous epithelium, this area often being raised to form what has been termed the "dermoid eminence." To this will be attached any other tissue present in this cyst. Teeth and bone (demonstrable by X-ray photography) are the commonest structures to be seen, but thyroid, cartilage, intestine, etc., may also be found. The covering of the dermoid area has the structure of skin, and long hairs may be growing at this site. Sebaceous glands, hair follicles and sweat glands are to be seen on microscopic examination.

Apart from the active area, the cyst wall has no epithelial lining; granulation tissue lying on a fibrous tissue base is all that can be detected.

Dermoid cysts increase in size slowly. Their liability to torsion has been mentioned, and they are liable also to infection and suppuration, especially when lying in the pelvis against the colon. If leakage of the contents occurs following rupture (as from trauma during parturition) an irritative peritonitis is set up which may result in dense adhesions and severe abdominal disturbance.

STRUVA OVARI.—A small tumour, partly solid and partly cystic, in which the predominating tissue present is identical with thyroid gland, is referred to under this term. In some cases thyroid elements only are found. It can hardly be doubted that such tumours are in reality atypical teratomatous growths.

(b) MALIGNANT TERATOMATA

Malignant Dermoid Cyst.—In about 2 per cent. of dermoid cysts malignant change occurs in the epithelial tissue—the change being one of squamous epithelioma. The condition is discovered, as a rule, at examination after operation, though secondary spread in the abdomen may be evident to the naked eye.

Solid Malignant Teratoma.—This tumour, of semi-solid type with a lobulated surface, grows rapidly and is most often found in young women. Ascites is common, and adhesions are often formed. The growth shows solid areas and cystic spaces, and contains a variety of embryonic tissues mixed together in a hopelessly irregular fashion. The tumour has a very high degree of malignancy, but fortunately it is extremely rare.

4. FUNCTIONING OVARIAN TUMOURS

Into this category there falls a small group of tumours which secrete hormones that influence the genital system, and sometimes the general state, of the patient. They possibly arise from early embryonic tissues remaining in the ovary which have neither undergone complete regression nor have progressed to maturer structures.

1. **Granulosa-celled Tumour** (Feminising Tumour).—The tumour develops mainly about the menopausal period, though in children

it may occur and be a cause of precocious puberty. It is usually unilateral, pedunculated and of a fibrous consistence with a smooth surface. In the larger growths degenerative cystic cavities are formed, and in colour it may be brownish with scattered yellow patches. *In contrast to the solid malignant growths, necrotic and friable areas are seldom seen*—a point of importance to the surgeon at the time of operation. Ascites is uncommon. One form of the tumour is rather fleshy in appearance and may resemble sarcoma, though the latter has a more hæmorrhagic homogeneous structure. Most granulosa-celled tumours are benign in character, though malignant forms, commonly bilateral, are also found.

Microscopically, various pictures may be seen in different parts of

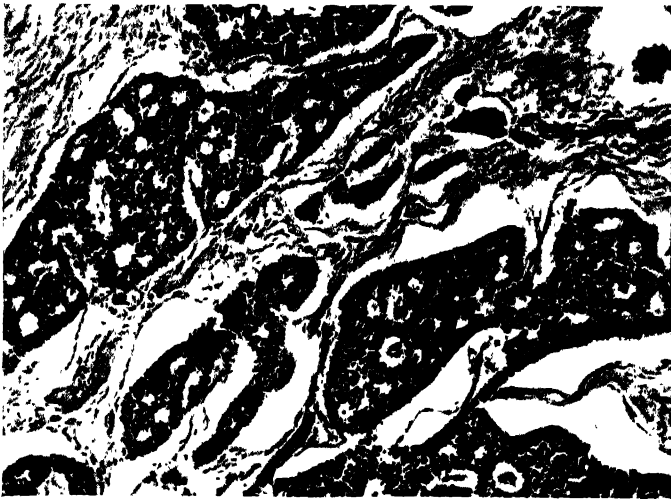


FIG. 404. —Granulosa-celled Tumour of Ovary. Photomicrograph.

the same tumour. The typical form shows islets of epithelioid cells imbedded in a fibrous stroma, the cells being arranged in a rosette pattern enclosing a small space containing an acid-staining fluid. Other areas show branching columns of uniform epithelioid cells which may suggest carcinoma, or even sarcoma.

The hormonal effect of the tumour is to cause enlargement of the uterus and hyperplasia of the endometrium leading to the production of irregular uterine hæmorrhage—an effect recognised especially in post-menopausal cases. For this reason the growth is regarded as a feminising tumour.

2. Brenner Tumour (Oöphoroma Folliculare).—Probably a variety of the granulosa-celled type, this solid growth is always of small size. It may be found in an ovary only slightly enlarged, in the wall of a pseudomucinous cyst or in the substance of a fibroma. Imbedded in a fibrous stroma lie clumps of large, pale epithelioid cells, in the

centre of which may be seen an ovum-like body, a fragment of tissue, the result of cell degeneration.

Brenner's tumour, seldom found before the menopause, may also cause bleeding from an enlarged uterus. It is always a benign growth.

3. **Arrhenoblastoma** (Masculinising Tumour).—In young women may be found a rare type of neoplasm, semi-solid in structure and usually unilateral. It is generally benign in character, but malignant forms have been noted.

Histologically, oval or polyhedral cells are arranged in cords with little intervening stroma.

Its main interest lies in its hormonal influence on the patient.



FIG. 405.—Brenner Tumour of Ovary.

Abnormal growth of hair, shrinkage of the breasts, enlargement of the clitoris, amenorrhœa—all these may be in evidence to denote the masculinising influence of the growth. After removal the symptoms disappear and the female attributes return, though the deeper pitch of voice, which may have developed, seldom alters appreciably.

B.—TUMOURS OF EXTRINSIC ORIGIN

These may occur either as the result of extension of malignant growths from the uterus, or of metastatic spread from other organs—*e.g.* breast, stomach, colon. In the former group it should be noted that extension of carcinoma from the uterine body is not uncommon; from the cervix it is much rarer. Sarcoma and chorionepithelioma also occur by direct extension.

The *metastatic group* is of great importance, for clinically there may be little to suggest that the ovarian tumours are secondary and not primary. Even at operation, search for a possible primary growth in the abdomen may be negative, though such a focus may be present. Secondary ovarian growths are generally bilateral, one tumour being larger than the other. They grow so rapidly that they often dominate the clinical picture. Ascites is the rule rather than the exception, and the early formation of adhesions to bowel and omentum is common.



FIG. 406.—Krukenberg Tumour of Ovary. Note the large “signet-ring” cells.

The tumours are usually of semi-solid consistence, sometimes markedly friable and bleeding readily on handling. Cystic and necrotic areas are commonly found. These metastatic tumours arise in two ways: either by implantation of cells on the ovarian surface or by retrograde lymphatic spread, the ovary being involved through the hilum. In many cases the aortic and lumbar glands are also involved, as has been shown in cases of primary breast and stomach carcinoma. A feature of interest lies in the similarity of the ovarian growths on microscopical examination to that of the primary tumour. We have found bilateral ovarian growths showing the picture of breast carcinoma three years after the primary breast tumour had been removed.

Krukenberg Tumour.—This is a special type of ovarian carcinoma generally secondary to gastric carcinoma. Almost always bilateral and

accompanied by ascites, the growths are solid with a smooth, often lobulated, surface. They may remain free from adhesions even when of fair size. The tumours are greyish in colour and often show degenerative cystic spaces. Histologically the significant feature is that of large mucinous epithelial cells with the nucleus pushed to one side, the so-called "signet-ring" cells. The cells are arranged diffusely and in adenomatous pattern, and they lie in a fibrocellular stroma which may resemble a sarcomatous structure very closely. Shaw states that Krukenberg tumours occur more frequently before than after the menopause, though the nine cases in our series all occurred after the menopause.

Chorionepithelioma.—This tumour is described under Malignant Tumours of the Uterus (p. 984). It may be encountered as a metastasis from such a tumour. One or two cases have been reported in which the tumour was primary or followed an ovarian pregnancy.

VI. BROAD LIGAMENT TUMOURS

Cystic Tumours.—In the broad ligament lie certain relics of Wolffian origin in the form of tiny tubular structures from which cysts may develop in adult life (Fig. 407). These cysts are benign in character.

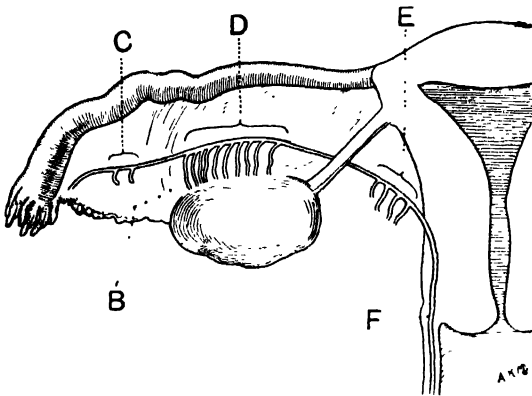


FIG. 407.—Wolffian Relics from which Cysts of the Broad Ligament may arise.

B. Fimbrial Cysts (Kethl). C. Kobelt Tubules. D. Epoöphoron (organ of Rosenmüller). E. Paröphoron. F. Gärtner's Duct.

FIMBRIAL CYST (Fig. 408).—This develops in the outer part of the broad ligament from relics adjacent to the ovarian fimbria, running from the tube extremity to the ovary. As the cyst enlarges it opens up the broad ligament, and is thus covered by peritoneum; the tube becomes elongated over the upper surface of the cyst, and

the ovary lies beneath it, gradually becoming compressed as the cyst grows. The fimbrial cyst may attain a large size; it has a thin glistening wall and contains clear watery fluid secreted from the cubical epithelium which lines it. It is unilocular, occasionally contains a few papillomatous projections and retains its benign character always. It is the only broad ligament cyst to grow large enough to be found on abdominal examination.

CYST OF THE PAROVARIIUM, OR EPOÖPHORON.—This develops in one of the vertical tubules of the parovarium lying in the mesosalpinx

beneath the Fallopian tube. It is a small unilocular innocent cyst, lined by columnar epithelium and containing a clear thin secretion. The tube above and the ovary below are quite separate from the cyst.

CYST OF PAROÖPHORON.—Occasionally a small cyst is found in the mesial part of the broad ligament close to the uterine wall, and growing from tubules in that situation.

CYSTS OF KOBELT TUBULES.—These are tiny cystic structures found beneath the outer end of the tube. Three or four of these cysts with short narrow stalks may be seen during pelvic operations. They are never associated with any symptoms.

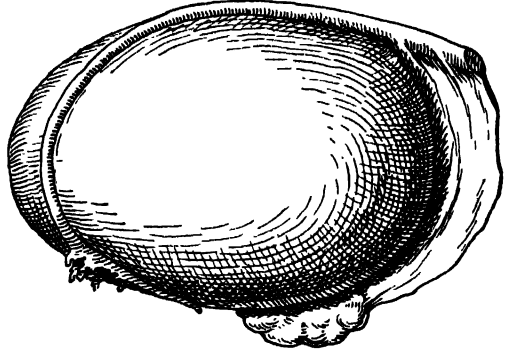


FIG. 408.—Fimbrial Cyst. Note the tube stretched over the cyst and the ovary beneath.

CYST OF HYDATID OF

MORGAGNI.—Such a cyst may be found as a very small structure with a thin pedicle of some length hanging free beneath the outer end of the Fallopian tube. It is of no clinical significance, being merely an oedematous modified fimbria of the tube.

Solid Tumours.—Solid tumours in the broad ligament are generally uterine fibromyomata which have grown laterally between the peritoneal folds of the ligament, though, occasionally, such a tumour may be present without any obvious connection with the uterus.

LIPOMA.—(On rare occasions tumours of this type have been found in the broad ligament, where they may attain considerable size.

(Carcinoma and sarcoma occur only as the result of infiltration from primary growths in the uterus or ovary.

VII. ENDOMETRIOMA

In the ovary of the adult there may develop foci of glandular tissue, microscopically identical with uterine endometrium, and reacting similarly to hormonal influences. The gland spaces are lined by columnar epithelium and surrounded by a cellular stroma. To this condition is applied the term "endometrioma." The tissue attempts to share in the process of menstruation and, as the blood cannot escape, it slowly accumulates in the gland spaces until retention cysts are formed which may become large enough to be recognised on clinical examination. The ovary may, indeed, become converted into a cystic structure as large as a golf-ball, which, owing to the dark chocolate-coloured blood that it contains, has been called a *chocolate cyst*.

The condition is often bilateral. Dense adhesions between the cysts and the surrounding structures are a feature of the condition. Small deposits of similar structure may be found on the uterine surface, bowel, or parietal peritoneum in association with the "chocolate cysts" (p. 1050).

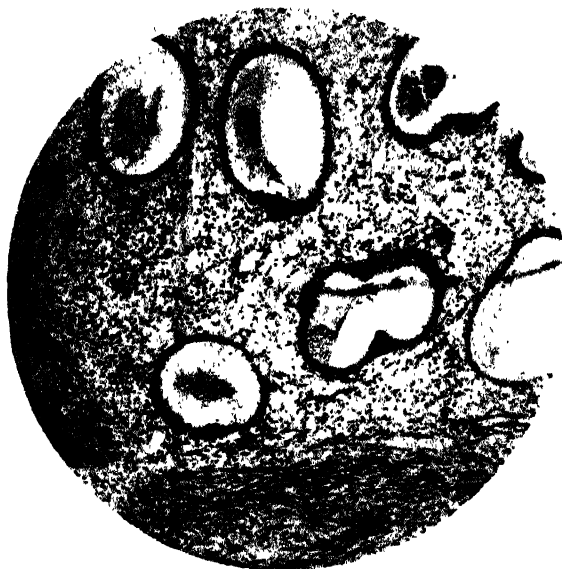


FIG. 409.—Endometrioma of Ovary. Glands lying in loose cellular stroma, so-called "cytogenous mantle."

Endometriomata (for the pathology of which see p. 954) are found mainly after the age of 30 years and in relatively sterile women. They give rise to increasingly severe menstrual dysmenorrhœa, the pain lasting throughout the periods and being followed by intermenstrual pelvic discomfort. In married women dyspareunia is a marked feature. Irregularity of menstruation is often

present. Examination reveals tender, enlarged ovaries which are *firmly fixed* in the pelvis, and movement of the uterus by the examining finger causes pain on one or both sides. The treatment is operative. Removal of the entire ovary is usually necessary, though resection of the diseased parts should be practised if healthy tissue can be conserved.

In women near the age of the menopause in whom the symptoms are comparatively slight, X-ray sterilisation may be considered, as the cessation of menstruation usually cures the symptoms.

CLINICAL FEATURES OF OVARIAN TUMOURS

We shall deal first and chiefly with ovarian cysts. Reference is made later to solid tumours of the ovary.

Clinical Features of Ovarian Cysts.—Ovarian cysts in their early stages are usually symptomless, and it may be only when the tumour rises into the abdomen that the attention of the patient or her friends is directed to her condition by the increasing distension. When early symptoms are complained of they are generally due to impaction in the pelvis producing pressure phenomena, or to torsion of the pedicle, or inflammation, or possibly rupture of the cyst. More commonly, symptoms occur relatively late and are due to the size of the tumour causing uncomfortable abdominal distension, pain from

localised peritonitis, and, in the later stages, cachexia, emaciation and exhaustion from the general drain on the system. The patient may then develop the *facies ovarica* of the old writers. Extremely large cysts are seldom seen now as they are diagnosed and removed early.

Ovarian tumours vary in the rapidity of their growth. Their rate of growth is more rapid than that of fibroids but very seldom as rapid as a pregnancy. *Menstruation is usually not affected*, though there may be a tendency to menorrhagia, and if bilateral ovarian tumours have destroyed all ovarian tissue there is amenorrhœa (p. 780).

Sometimes ovarian tumours cause functional activity of the mammæ, and this possibility must always be borne in mind in the differential diagnosis of a pregnancy.

(1) *Physical Signs of an Intrapelvic Tumour*.—As already mentioned, it is rare for such tumours to produce symptoms unless they are fixed or impacted, or sessile—*i.e.* growing between the folds of the broad ligament. They are often discovered accidentally on vaginal or bimanual examination when the pelvis is being explored for diagnostic purposes. The presence of a round, non-sensitive cystic swelling, behind, in front, or on one or other side of the uterus, can be recognised. The uterus can be distinguished as separate from and more or less independent of the tumour. In a sessile tumour the uterus is in close contact with it, and separated from it only by a groove. In some cases it may be necessary to use the uterine sound to differentiate between the uterus and the tumour, and it may be advisable to examine under an anæsthetic. Rectal examination sometimes gives valuable assistance in difficult cases.

Pelvic tumours often give rise to pressure symptoms involving the bladder, and may even produce retention of urine. The bladder may become greatly distended, even to the extent of causing an abdominal swelling, and it is of the highest importance to catheterise the bladder in all doubtful cases before venturing on a definite diagnosis of the condition. As a rule a distended bladder is tender on palpation and gives rise to a more superficial feeling of fluctuation than a cyst.

(2) *Physical Signs of an Abdominal Tumour*.—When the tumour has grown up into the abdomen, the patient may complain of pressure symptoms, dyspnœa, palpitation, vomiting, flatulence and pain. Pain may be present, apart from pressure, owing to changes occurring in the tumour itself—localised peritonitis, torsion, inflammation or possible rupture of the cyst.

Ascites may be present with innocent tumours, especially if the tumour is solid, but its presence should always make one suspicious of malignant or papillomatous conditions.

The abdomen should be examined methodically by inspection, palpation, percussion and auscultation.

On inspection the enlargement of the abdomen can be recognised,

usually lateral when the cyst is beginning to rise into the abdomen, but becoming more central as it increases in size. The swelling has a more sloping outline, as a rule, than a fibroid, and if it has grown rapidly, recent striæ may be observed on the abdominal wall.

On palpation the tumour is usually smooth in outline, with an elastic or fluctuating sensation, depending on the nature of its contents and the number of loculi it contains. Occasionally localised bulgings can be felt, due either to the projection of loculi, or to a mass of more solid consistence situated in the tumour wall. Unless very large, the tumour is usually mobile and can be displaced to some extent laterally. When the fingers are pressed down into the pelvic brim, the tumour is found to extend downwards into the pelvis. In exceptional cases, where the pedicle is very long and the tumour very movable, it may be impossible to recognise any pelvic connection. There is no alteration in the consistence of the tumour comparable to the intermittent contractions of the pregnant uterus.

The percussion note is dull over the tumour, and resonant in the flanks, and the area of dullness does not alter on changing the position of the patient unless ascites is present. A fluid wave can often be elicited if there is a large unilocular cyst with contents of low specific gravity.

Auscultation gives negative results: occasionally coarse friction can be heard when there is localised peritonitis. In rare cases of intraligamentous tumours, with the uterus raised into the abdomen, a souffle can be heard.

On vaginal examination, the cervix is found to be of normal consistency, and is often somewhat low in the pelvis. The uterus is usually pushed down by the tumour, may be anteverted or retroverted, and may be difficult to palpate bimanually. If retroverted, it may be more easily felt per rectum. When the tumour is sessile, the uterus may be pushed to the opposite side, or upwards into the abdomen, where it may be felt under the abdominal wall.

Symptoms and Signs of Malignancy in Ovarian Tumours.—Pain, metrorrhagia, rapid enlargement of the abdomen and ascites, associated with emaciation and cachexia, are commonly present. Early fixation of the tumour mass recognised by abdominal and vaginal examination is characteristic, and early œdema of one or other leg, before the tumour has attained a great size, is suggestive of malignant infiltration of the pelvic tissues on the corresponding side. Not infrequently bowel can be recognised by percussion as passing in front of a fixed malignant ovarian tumour.

Symptoms and Signs of Broad-ligament Cysts.—These cysts are of slow growth, and have thin walls. They are usually unilocular with thin, watery contents so that fluctuation and a fluid wave can generally be distinctly recognised. They usually displace the uterus laterally or even upwards, and the mobility of the cyst is generally restricted.

An absolute diagnosis cannot, however, be made till the abdomen is opened, when the characteristic conditions already mentioned can be readily recognised.

DIAGNOSIS

This is sometimes extraordinarily difficult. It may involve a wide field of inquiry, embracing almost the whole field of gynæcology, the question of pregnancy and the pathology of other abdominal viscera.

When the tumour is pelvic, or mainly so, one must always eliminate : (1) a distended bladder, and (2) fæcal accumulation in the pelvic colon.

In doubtful cases no opinion should be given till the bladder has been emptied by a catheter and the rectum evacuated by enemata. Careful bimanual examination should then be made, if necessary

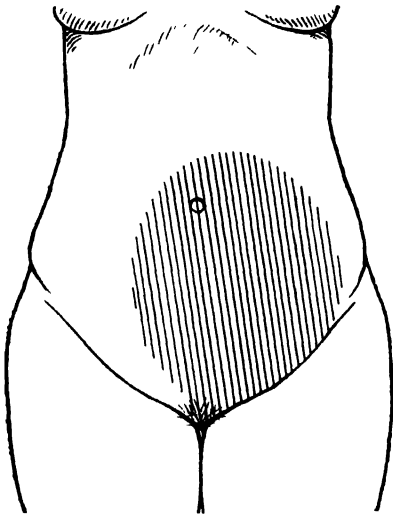


FIG. 410.—Outline of Dullness in an Ovarian Tumour.

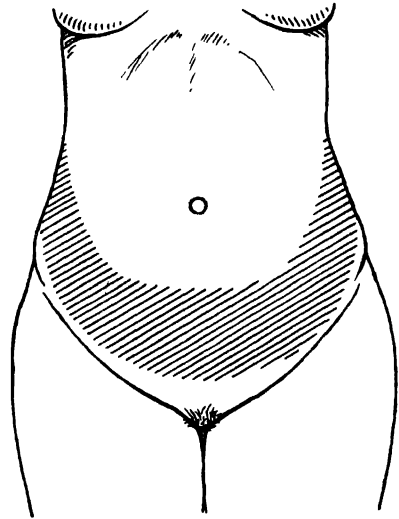


FIG. 411.—Area of Dullness in Ascites.

under an anæsthetic, when the pelvic condition can be accurately ascertained. Fæcal masses have been mistaken for solid neoplasms of the ovary, but unless very indurated they can generally be indented by pressure of the finger through the vagina, and so recognised.

The two common uterine conditions to be distinguished from an ovarian neoplasm are pregnancy and a uterine fibromyoma. A subperitoneal uterine fibroid attached to the uterus by a long pedicle closely resembles an ovarian tumour. It is, however, usually harder in consistence and does not grow so rapidly as an ovarian tumour. Fibroids are frequently multiple, causing irregular enlargement of the uterus, and there will usually be a history of menorrhagia in such cases.

Early pregnancy, especially if the uterus is retroflexed, may be mistaken for an ovarian cyst lying in Douglas's pouch. The absence

of the fundus uteri from its normal position, the variations of consistence of the pregnant uterus because of its characteristic intermittent contractions, and the possibility of replacing the uterus to its normal position, combined with careful investigation of the signs and symptoms of early pregnancy, should enable the diagnosis to be established. When in doubt, a later examination should be made and in the interval the Aschheim-Zondek test should be carried out. When Hegar's sign is present in a normal pregnancy, care should be taken not to mistake the firm cervix for the body of an empty uterus, and the soft enlarged body for a cyst.

An ovarian cyst may, of course, sometimes be found along with a normal pregnancy.

Tubal conditions, such as hydro- or pyosalpinx or tubal gestation, have also to be borne in mind, and may resemble a small inflamed ovarian tumour. In hydro- and pyosalpinx the history of pelvic inflammation (septic, gonorrhœal or tuberculous) can generally be elicited, and the elongated shape of the tubal swelling is often characteristic.

In tubal pregnancy the swelling is usually lateral (unless there is an associated hæmatocœle), the uterus is often enlarged, there is great vascularity and considerable tenderness, and, if the ovum has not died, the rate of growth is rapid. The history here is of great importance.

Encysted serous peritonitis of tuberculous origin or a suppurating cellulitis may be mistaken for an ovarian cyst. In the latter, the history, the raised pulse-rate and temperature, the tenderness and fixation of the mass, will help to differentiate the condition.

DIFFERENTIAL DIAGNOSIS.—The following conditions may closely resemble an ovarian tumour :—

- (1) Adiposity.
- (2) Flatulent distension of the bowel, and pseudocyesis.
- (3) Free fluid in the abdominal cavity.
- (4) Encysted fluid as in tuberculous peritonitis.
- (5) Distended bladder.
- (6) Fæcal accumulation.
- (7) Pregnancy (p. 178), specially with hydramnios.
- (8) Uterine fibroids.
- (9) Tumours of other abdominal organs and echinococcal cysts.

Adiposity may be mistaken for a neoplasm, or may render it difficult to detect the presence of an associated ovarian cyst. Deep percussion usually yields a uniformly tympanitic note in a fat abdomen, and abdominal palpation reveals the presence of the fatty superimposed layer superficial to the abdominal muscles. The umbilicus is deep in the fat abdomen, and is shallow when the abdomen is distended by an ovarian cyst. In difficult cases an examination under anæsthesia will be necessary.

Flatulent distension of the bowel and pseudocyesis are characterised

by the uniform tympanitic note on percussion, and often peristaltic movements of the bowel can be recognised.

Free fluid in the abdominal cavity may cause a uniform enlargement of the abdomen. In such cases the abdomen is usually flattened in front and the flanks tend to bulge. The fluid wave can generally be elicited, and on percussion with the patient on her back the flanks are dull and the centre of the abdomen is resonant. The area of dullness will alter with the change of posture, producing a "shifting dullness" which is not present in an ovarian tumour. There may be free fluid in the abdomen, however, along with an ovarian tumour, especially if it is malignant, or if the tumour has ruptured.

Encysted fluid in the abdomen may easily be mistaken for an ovarian cyst, and an absolute diagnosis can sometimes be made only after the abdomen has been opened. The general condition of the patient, the presence of tuberculosis in other organs, evidences of malignant disease, the temperature, and the tenderness of the abdomen must all be taken into consideration in such cases in coming to a diagnosis.

Distended bladder and faecal accumulation have already been considered, and must always be eliminated in doubtful cases. A distended bladder is often associated with an intrapelvic tumour, which may render the passage of the catheter difficult, and care must always be taken to use a long catheter to ensure its passing well into the bladder and reaching the accumulated urine.

The bladder may be distended even up to the epigastric region, and the possibility of the "paradoxical incontinence of retention," so often present in such cases, must never be forgotten.

Normal or abnormal pregnancy may be mistaken for an ovarian tumour. Pregnancy is the commonest cause of an abdominal tumour, and must always be kept in mind as a possibility during the child-bearing age. The differential diagnosis is discussed under Pregnancy. It should be remembered that ovarian tumours and pregnancy may coexist.

Uterine fibroids grow more slowly than ovarian tumours, and unless pedunculated are intimately bound up with the uterus. They are usually solid in consistence, and may be irregular in outline. A uterine souffle may occasionally be recognised, which is never present in an ordinary ovarian tumour. When a fibroid is soft, or has undergone cystic change, the differential diagnosis may be very difficult, or even impossible.

Tumours of other abdominal organs may simulate an ovarian tumour, such as renal tumours, tumours of the omentum, mesentery, pancreas or spleen, and hydatid cysts. Renal tumours always lie behind the colon, the latter being recognised by its tympanitic note in front of the tumour. Single or "horse-shoe" kidneys sometimes lie in the hollow of the sacrum. These are all rare conditions, but the possibility of their occurrence must be kept in mind.

Clinical Features of Solid Ovarian Tumour.—The differentiation between the pathological varieties of ovarian tumour is often a matter of great difficulty, and is usually ascertained with certainty only during the course of the operative procedures which are required for all such tumours, or after pathological examination of the specimen. Solid tumours are much harder and heavier to palpation. They are much less frequently encountered than cystic growths. On the other hand they are much more frequently malignant. Ascites is a not uncommon feature both in malignant and non-malignant solid tumours (*vide* Fibroma, p. 1007). They rarely simulate a pregnancy, but on the other hand many of them closely resemble a pedunculated fibromyoma.

COMPLICATIONS OF OVARIAN TUMOURS

The commonest complications of ovarian tumours are axial rotation of the pedicle, hæmorrhage into the cyst, septic infection and suppuration. rupture of the cyst, incarceration of the cyst, and malignant degeneration; and if injured during labour, necrosis (p. 664).

Torsion of the Pedicle.—An ovarian cyst derives its blood supply through the pedicle, and if the tumour should undergo rotation on its axis, the pedicle will become twisted and the blood supply will consequently be interfered with in proportion to the amount of twisting which takes place.

Torsion may occur slowly or acutely. When it occurs slowly, with a long and thin pedicle, the tumour quickly becomes adherent to surrounding structures, and it may ultimately derive a new blood supply from omental or other vessels, converting it into a so-called "parasitic tumour" with its original blood supply completely or partially cut off because of slow atrophy of the pedicle. More commonly the torsion is acute from rapid repeated rotation of the tumour. The thin-walled veins of the pedicle are first affected, the venous return is consequently interfered with and the more resistant arteries continue to convey blood into the cyst. The result is great venous engorgement of the tumour, with extravasation of blood. Hæmorrhages into the cavity of the cyst take place from rupture of the veins, producing rapid enlargement of the tumour, and even in some cases leading to its rupture. Some uterine bleeding is commonly seen in such cases.

Intestinal and omental adhesions quickly form, but are easily separated if operative measures are carried out early. There is a danger of invasion of the congested and devitalised tumour by organisms from the bowel. The torsion may be so acute as to cut off the arterial supply as well, and bring about strangulation and gangrene of the tumour and peritonitis, with fatal results.

The degree of rotation varies from half a circle to as many as twelve

complete turns. Three or four twists are by no means uncommon. The rotation may be in either direction, but the common tendency is for the anterior surface or pole of the tumour to rotate mesially.

We generally find that rotation is most apt to occur with a small or medium-sized cyst with a long pedicle. Pregnancy and the puerperium seem to favour the occurrence of rotation, probably owing to the laxity of the ligaments and displacement of the tumour associated with these conditions. Sudden exertion, unequal growth of the tumour or the peristaltic action of the intestines may also be factors in bringing it about. Rotation may occur, however, without any apparent cause.

The symptoms vary with the degree of torsion. In the slow forms the patient complains of recurrent abdominal pains. There may be a rise of temperature and a quickened pulse, and the tumour will be tender on palpation, and will probably have become denser in consistence.

In the acute variety of torsion the patient is suddenly seized with the symptoms of an "acute abdomen"—severe abdominal pain and vomiting. The pulse is rapid and feeble, the temperature usually subnormal at first, and the facial expression indicative of acute distress. On examination of the abdomen, the tumour is felt to be tense, tender and hard, and there may be a history of rapid enlargement. The symptoms may simulate acute intestinal obstruction, acute appendicitis, rupture of a gastric ulcer or of an ectopic pregnancy. The presence of the tumour, the absence of stercoraceous vomiting and the history of the case usually enable one to come to a correct diagnosis.

Hæmorrhage into a cyst may occur apart from torsion of the pedicle. It may result from spontaneous rupture of a thin-walled vessel or from trauma such as may occur during labour or from a blow on the abdomen. Clinically it does not give rise to such acute abdominal symptoms as are generally found in cases of axial rotation of the pedicle, but there is abdominal pain and the cyst may increase in size, become more tense and is tender on palpation.

Septic Infection of an Ovarian Cyst is a rare occurrence nowadays. Formerly it was more common, when it was the custom to tap ovarian cysts through the abdominal parietes. It may occur, as stated above, as the result of torsion of the pedicle. It tends to occur more frequently in cystic teratomata, and is *specially liable to take place after labour or abortion*, probably from traumatism (p. 550). The cyst is usually adherent to adjacent structures including bowel, from which the infecting organisms originate, and the contents may suppurate. Occasionally the cyst may evacuate itself into the intestine or bladder. The symptoms are pain, a rising temperature, evidences of toxic absorption with leucocytosis, associated with a fixed and tender tumour, which tends to increase rapidly in size.

Rupture of an Ovarian Cyst may occur spontaneously or may be

the result of injury, or too vigorous an examination under anæsthesia. It is liable to occur during pregnancy or labour. Some cysts are specially liable to rupture, such as thin-walled ovarian and broad-ligament cysts; also pseudomyxomatous cysts with very gelatinous contents, and papillomatous cysts, owing to the erosion of the cyst wall produced by the papillomatous outgrowths. It is rare for a suppurating cyst to burst into the peritoneal cavity, as the surrounding adhesions tend to prevent it.

In acute rupture of a cyst the symptoms may resemble acute torsion of the pedicle, but on examination the tumour will have disappeared or have become much reduced in size; there will be free fluid in the peritoneal cavity, and there may be signs of internal hæmorrhage. If the contents of the cyst are non-irritating and there is no internal hæmorrhage, the symptoms may be slight. The tumour will be found to have disappeared or have diminished in size, the patient may pass a large amount of urine and the escaped fluid may quickly be absorbed. As a rule, the escape of fluid is gradual, from a small opening in the cyst, and may be discovered only during operation. If a broad-ligament cyst ruptures, the fluid may become entirely absorbed and the tumour may never reappear.

If the tumour is simple and the fluid non-irritating, no serious results may follow rupture, provided no internal hæmorrhage occurs.

Under two conditions complications may occur. In the first instance, when a pseudomyxomatous cyst with friable walls, full of jelly-like contents, ruptures, the abdomen may become filled with the pseudomyxomatous material. The gelatinous masses and probably also some of the secreting tumour cells become attached to the peritoneum and surrounding viscera, and the condition known as *pseudomyxoma peritonei* may result, causing great distension of the abdomen. After the removal of the original tumour, and the clearing out, so far as possible, of the jelly masses from the peritoneal cavity, there is sometimes no further recurrence, but usually the gelatinous material goes on reaccumulating, necessitating repeated operations for its evacuation. The condition is not actually malignant, and appears to be more of the nature of metastatic implantation, causing continued secretion of the gelatinous material (see p. 1000).

In the second instance, where a papillomatous tumour ruptures, the papillomatous growths are liable to become implanted on the peritoneum, where they continue to grow and produce ascites. These papillomatous implantations are apt to become locally malignant, but sometimes they disappear after the original tumour has been removed.

Incarceration of an Ovarian Tumour may occasionally occur, either as the result of adhesions or from simple impaction in the pelvis, giving rise to characteristic pressure symptoms.

Malignant Changes in Ovarian Cysts have already been considered. Probably they are commoner than was formerly supposed, and

microscopical investigation sometimes reveals malignant foci in tumours which seem clinically innocent.

TREATMENT

Early removal is clearly indicated for all ovarian and broad-ligament tumours as soon as they are diagnosed. The sooner they are removed, the safer for the patient, as at any time complications may arise which would render operative measures more serious, and there is always the possibility of a malignant focus even in an apparently simple case. Even in cases diagnosed as being malignant, an exploratory operation should be performed, as has been already explained.

The abdominal route should be the operation of choice, and bearing in mind the possibility of malignancy in all cases, it is safer not to tap the tumour, but, even though it be of large size, to remove it entire through a free abdominal incision. In uncomplicated cases ovariectomy in experienced hands is one of the safest operations in abdominal surgery. The mortality, taken all round, should not exceed from 2 to 5 per cent. It is higher, however, than that of hysterectomy for uterine fibromyomata owing to the greater frequency of complicating conditions, such as adhesions, in association with ovarian tumours.

The operation of ovariectomy and other operations on the ovary are described in Chapter LVII (p. 1123).

OVARIAN TUMOURS COMPLICATING PREGNANCY, LABOUR AND THE PUERPERIUM

This subject has been discussed in the obstetric section. Ovarian tumours as a complication of pregnancy are considered in Chapter XIV (p. 297), as a complication of labour in Chapter XXXI (p. 550), and as a complication of the puerperium in Chapter XXXVII (p. 664).

Pregnancy does not seem to influence appreciably the rate of growth of ovarian cysts, but it undoubtedly tends to produce secondary changes in them, which may be a source of very real danger. All writers have remarked on the high proportion of dermoid tumours found in association with pregnancy—McKerron 23 per cent., Spencer 27 per cent. in their respective series.

The chief risks are :—

- (1) Axial rotation of the cyst, which is much more frequent than in the non-pregnant state.
- (2) Rupture of the cyst.
- (3) Incarceration of the cyst in the pelvis.
- (4) Embarrassment of respiration when a large ovarian tumour coexists with the pregnant uterus.
- (5) Predisposition to the occurrence of abortion or the onset of premature labour.

In view of these undoubted risks, the removal of ovarian cysts complicating pregnancy is always indicated. The risk of abortion or miscarriage being caused by the operation can be greatly reduced nowadays by large doses of progesterone for some days before and after the operation (*vide* p. 334).

Ovarian Tumours complicating Labour.—When an ovarian tumour is discovered only after the onset of labour it may either be high up in the abdomen or may be lodged in the pelvis. When it is in the abdomen it runs the risk of axial rotation, rupture, and possible bruising and subsequent suppuration or necrosis. If any of these complications develops, the safest plan is to operate at once, even when labour is in progress, otherwise it may be left till after delivery, and operated on during or after the puerperium.

When the tumour occupies the pelvis it mechanically obstructs delivery. Gynæcological literature shows that the tumour or the uterus may rupture, or, in rare cases, the tumour may be extruded through a rupture in the vagina, or even through the anus.

Recourse may be had to one or other of two lines of treatment. If the tumour can be pushed above the pelvic brim, and provided that the labour has not progressed too far, delivery of the child may be accomplished without damaging the cyst. No attempt must be made to pull the child through while the tumour still occupies the pelvis. The dislodgment of the tumour from the pelvis is not unattended with risks, as rupture or twisting of the cyst may take place.

In the second place, if the cyst is firmly incarcerated in the pelvis, and it cannot be pushed up, ovariectomy should at once be performed, and it may be necessary in some cases to perform Cæsarean section at the same time in order to gain access to the cyst. Occasionally in multiparæ, removal of the cyst *per vaginam* has been resorted to but is not advised (*vide* p. 1070).

Ovarian Tumours in the Puerperium.—There may have been considerable bruising of the cyst wall during the labour, and as a result *necrosis* or *secondary infection* of the tumour. Ovariectomy may therefore be necessary within forty-eight hours of delivery. Similarly if the cyst has ruptured or has undergone axial rotation, immediate operation may be necessary. If no such complications have arisen the operation may be delayed till later, when the patient has recovered from the confinement.

CHAPTER LI

DISEASES OF THE FALLOPIAN TUBES

Salpingitis—Cysts and Solid Tumour of the Fallopian Tubes—
Hæmatosalpinx

INFLAMMATORY DISEASE OF THE FALLOPIAN TUBES

THE structure and situation of the Fallopian tubes in the lower abdomen explain their susceptibility to infection, and further, why tubal inflammation is never primary but is always secondary to infection in another organ.

The infection may arise in one of four ways :—

- (a) Direct spread upwards through the tubal opening from the uterus, cervix or vagina—*e.g.* gonorrhœa ; also postabortum sepsis, postoperative infection, infected fibroid or cervical carcinoma, but spread in them may be by lymphatics.
- (b) Spread *via* the lymphatics of the broad ligament from uterus, cervix or vagina—*e.g.* puerperal streptococcal infection.
- (c) Spread by the blood-stream—*e.g.* tuberculosis, scarlet fever.
- (d) Spread by continuity from adjacent abdominal organs—*e.g.* appendix or diverticulum of colon.

Tubal infections, the result of (a), (b) and (c), are almost always bilateral, though one side may be more seriously involved than the other. Infections resulting from the appendix may be limited to the right tube and from a diverticulitis to the left tube (most commonly) ; but if a pelvic abscess forms from either of these two conditions both tubes may be affected.

The relative incidence of these different infections has been discussed in the introductory paragraphs to Chapter XLV.

ACUTE SALPINGITIS

Puerperal and gonococcal infections are the important causes of acute salpingitis, though an acute tubal lesion may arise in association with a sloughing fibroid of the uterine cavity, or a grossly infected carcinoma of the cervix. In puerperal cases the tubal lesion is rarely seen alone : it is usually part of an extensive pelvic infection involving uterus, ovaries, connective tissue and peritoneum (p. 1040). In

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gonorrhœal infection the spread is along the mucous membrane. But a gonococcal infection is soon followed by a superimposed invasion by streptococci, staphylococci, coliform bacilli, which are probably responsible for the grave lesions which ultimately develop. Thus it may be impossible to determine whether the primary infection was originally gonorrhœal, unless there is a definite history of gonorrhœal infection.

In the acute phase of infection, both tubes are markedly inflamed and swollen. If the abdomen is opened they are seen to be angry and red; the abdominal ostia may be pouting with discharge exuding from them. The pelvic peritoneum is injected and serous exudate may be present in the pouch of Douglas. The condition may clear up rapidly in milder cases, or the tubes may become distended with pus—*acute pyosalpinx*. In the latter event the narrow lumen of the uterine ends of the tubes become early blocked by the inflammatory swelling in their walls. The outer ends also become closed, either by the indrawing of the adherent fimbriæ or by adhesion of the fimbriæ to one another and to the neighbouring structures. The former method of closure is more common in gonorrhœal infection, the latter in puerperal infections. In either type of infection the ovary is almost invariably involved in the inflammatory process. When pus forms in the ovary a *tubo-ovarian abscess* may result.

CLINICAL FEATURES.—The onset is associated with a febrile temperature, a rapid pulse, acute pain and rigidity in the lower abdomen. Rigors may occur. In practice it may be difficult to distinguish the onset of an acute salpingitis, because it occurs as an incident in an acute gonorrhœa or in a febrile puerperium. Further, the symptoms resemble very closely those of an acute appendicitis. The chief aid in the differential diagnosis of acute salpingitis of gonorrhœal origin from appendicitis is the history. With gonorrhœal salpingitis there is generally a history of purulent vaginal discharge and bladder irritation; but these symptoms are not infrequently concealed or latent. With appendicitis, on the other hand, there may be the history of previous attacks of abdominal pain, or chronic gastric or intestinal disturbances of old standing.

The distribution of abdominal rigidity may not help very much. In appendicitis rigidity is more localised than in salpingitis at the commencement of the attack; but if any spread of infection to the peritoneum occurs the whole lower abdomen may become tender and rigid.

Recurrence of vomiting, too, suggests an appendical origin of the disturbance, and after the first day the patient appears more seriously ill. What adds to the difficulty in some instances is that one tube is often more affected than the other. Should this be the right tube it is obvious that it may be very difficult to differentiate acute salpingitis and appendicitis except from the history.

Turning to acute salpingitis in the puerperium—here the recent

delivery and the gradual appearance of the signs of an acute inflammatory pelvic lesion in the vast majority of cases make the diagnosis easy. However, an attack of appendicitis may occur quite independently, early in the puerperium, in which event differential diagnosis may be singularly difficult (p. 658).

TREATMENT.—The treatment of the puerperal and gonorrhœal types is much more conservative than it was a number of years ago.

The treatment of salpingitis with peritonitis of *puerperal origin* has been already described (p. 647). If a patient is already very ill by the third or fourth day of the puerperium, and is evidently becoming rapidly worse, abdominal drainage may save her, but only very occasionally. Later, if the condition has been going on for weeks with continued fever and no progress towards recovery, removal of tubes and uterus may have to be considered.

In *gonorrhœal cases* surgical treatment is seldom required: in most cases more or less complete recovery takes place by the employment of medical methods. The patient should be kept absolutely at rest in bed on milk diet: abdominal fomentations, ice-bags and hot vaginal douches may be required for the local relief of pain. When the pain is extreme and appendicitis has been definitely excluded as a possible diagnosis, morphia may be given. The treatment of the vagina and cervix in gonorrhœa has been described in Chapter XLV (p. 870). Drainage through the posterior fornix is advisable if a pelvic abscess forms.

Removal of acutely inflamed tubes is a dangerous procedure (particularly in puerperal cases). When the abdomen is opened in cases of doubtful diagnosis, nothing more than drainage of the lower abdomen should be carried out if the condition prove to be a salpingitis—naturally, if it prove to be an appendicitis the appendix is removed and drainage established if necessary.

CHRONIC SALPINGITIS

According to the virulence of the infection, chronic salpingitis may take the form of *hydrosalpinx* or of *chronic purulent salpingitis*: the latter type may occur either as a *salpingo-oöphoritis* or as a *pyosalpinx*.

Hydrosalpinx.—Here the typical history is an infection of low virulence producing a catarrhal salpingitis. Both tubes are generally affected.

The tube becomes converted into a closed cavity in the manner already described (p. 1028). The normal tubal lumen increases very markedly from its narrow uterine end outwards, and so the closed distended tube assumes the form of a retort, on the spherical outer end of which it may often be possible to observe a dimple marking the original ostium (Fig. 412). The tube becomes very much elongated, and as a result of the anchoring of this elongated swelling by the peritoneal folds of the broad ligament the form of the tube is usually tortuous.

The tubal epithelium becomes flattened out, and the original plicæ can generally be identified in the wall as little irregular ridges. Adhesions between the plicæ may take place and minute retention cyst may be formed in the tube wall.

The contained fluid is usually clear, though it may be blood-stained, and, in almost all cases, is sterile. The tube wall is much thinned out, with very little muscle tissue persisting. The sacs are elastic to touch, and are insensitive. They are generally mobile as owing to the mild infection, adhesions to the surrounding structure are absent or only slight.

A hydrosalpinx does not usually take long to reach a stationary condition. In a few cases the uterine ostium is not completely closed, and, when the tube becomes distended, the fluid may on occasion

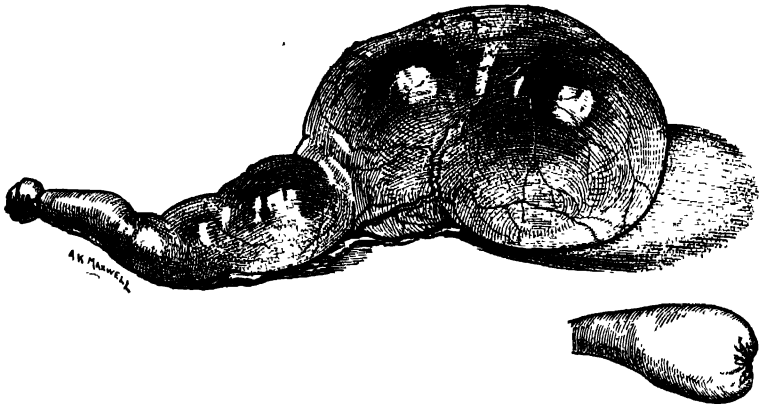


FIG. 412.—Hydrosalpinx.

Inset shows retracted fimbriae and dimple marking where the abdominal ostium was originally situated.

escape through the uterine cavity, giving rise to the condition of “*hydrops tubæ profluens*.” This condition is rare, and is characterised by the intermittent discharge of a large amount of watery fluid from the vagina with temporary collapse of the hydrosalpinx.

Infection of a hydrosalpinx from the bowel or other neighbouring organ seldom occurs, owing to the absence of adhesions: *rupture* seldom occurs, but does happen more often than in pyosalpinx. *Torsion* of the sac may take place, a phenomenon very seldom seen in pyosalpinx, where the adhesions are usually so pronounced as to prevent either rupture or torsion.

The distended tubes usually require removal. Where the distension is not extreme, an attempt should be made to conserve the tube and to establish a new ostium by the operation of salpingostomy (p. 1130).

Chronic Purulent Salpingitis.—Here we may find two forms of lesion: (1) *pyosalpinx*, where the tubes are distended with pus, and (2) *salpingo-oöphoritis*, where the tubes and ovaries are thickened and sclerosed possibly without the ostia becoming closed.

While the puerperal and gonorrhœal types may not differ very markedly in appearance, the retraction of the fimbriæ to the inside of the distended tube seems to be more characteristic of the gonorrhœal type. In the puerperal form the fimbriæ may still be identified in the adhesions which surround the outer end of the tube ; because the mucous membrane is the layer originally infected in the former, while the spread in the latter is generally by way of the lymphatics and therefore from without inwards.

The form of a *pyosalpinx* is that of a retort, just as we find in hydro-salpinx. The fimbriæ may be retracted, or identifiable in adhesions. The lesion is usually bilateral, since the infection spreads from the uterus, but one tube is usually larger than the other (Fig. 413). The

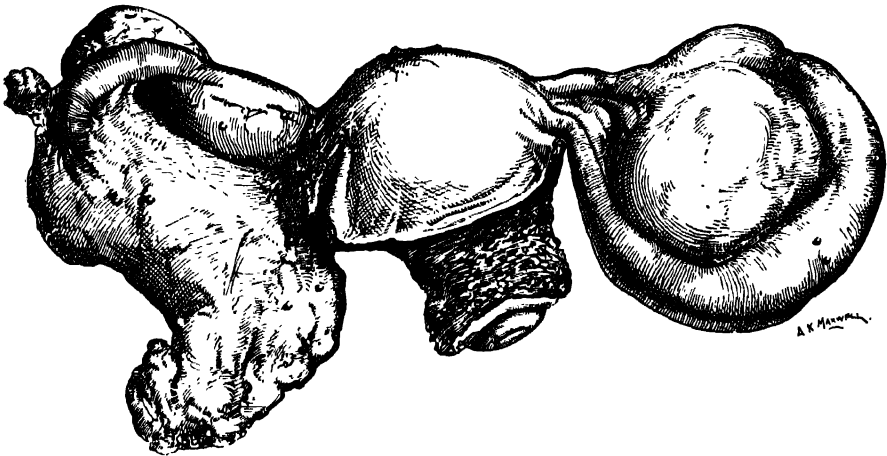


FIG. 413.—Double Pyosalpinx (Puerperal).

matting of the pelvic organs may be very intimate and involve the reproductive organs, loops of bowel, the appendix ; and the omentum may be drawn down and adherent to the whole mass. These dense adhesions help to prevent rupture of the tubes, and render torsion of tubes impossible. Collections of pus may be found in the vicinity of the tubes, but *these are peritubal and not due to rupture*. While the original pyosalpinx very seldom ruptures, these peritubal collections of pus may develop into considerable abscesses, which on occasion may rupture into the bowel or into the general peritoneal cavity.

The tube wall in a pyosalpinx is much altered : the muscle coats may still be identified, but the greater part is connective tissue. The tissue is infiltrated with leucocytes and contains numerous plasma cells. Small retention cysts may be seen in the wall, the result of adhesion of plicæ of the mucous membrane. The original epithelium of the tube becomes disorganised and is replaced by granulation tissue ; in a few areas, patches of rod-shaped cells represent the original ciliated epithelium.

The pus in the puerperal and gonorrhœal types is usually thick,

and, except where there has been infection with *B. coli*, odourless. Within a few months of the original lesion the pus becomes sterile; but live streptococci may remain dormant for a very long time in the cellular tissue around the tubes. Furthermore, owing to the intimate adhesions between tubes and bowel, infection from the latter may occur at any time, should local and general resistance become lowered. *This is the explanation of the recurrent attacks of pelvic peritonitis which, as pointed out later, is the outstanding clinical feature of chronic pyosalpinx.*

In the type described as *salpingo-oöphoritis*, great distension of the tubes is absent—tubes and ovaries are matted together into irregular masses. The lumen is narrowed and there may be nodular cellular thickenings (*salpingitis nodosa*) in the course of the tube wall, with extensions or diverticula from the lumen (p. 957). These diverticula are lined with columnar epithelium; this condition is frequent in tuberculous salpingitis which we will now consider.

Tuberculous Salpingitis.—This type of salpingitis occurs in 5 to 10 per cent. of cases. In a number of cases the tuberculous infection is superimposed on another infection—*e.g.* a puerperal infection. Owing

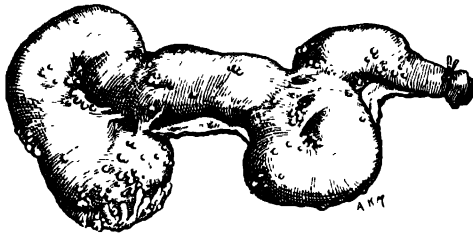


FIG. 414.—Tuberculous Pyosalpinx.

Note the fimbriae of tube are not retracted and tube is tortuous. A few tubercles are seen on surface.

to lowered local resistance conditions are made favourable for the tubercle bacillus to become implanted.

The route of infection is generally by the blood-stream; but where a tuberculous peritonitis exists the tubes may become involved by direct implantations of tuberculous nodules. At an

early stage these tuberculous nodules are limited to the peritoneal and muscular coats of the tube without the mucous membrane being affected. When such appearances are found at a laparotomy, the tubes should be conserved, as tuberculous peritonitis and the tubal condition often improve after laparotomy (p. 881).

The tubes may be quite free and are sometimes of an oatmeal colour. Where the case is more advanced, the tubes are greatly distended and densely adherent to the surrounding structures. In some cases tuberculous salpingitis is only diagnosed after microscopic examination, but in most the macroscopic appearances are characteristic. The surface of the tube is studded with tubercles, and the tube wall is thickened and nodular (Fig. 414). The fimbriae are adherent but not retracted; the tube may be distended with caseous debris. The nodules are made up of thickened fibrous tissue with some muscle fibres and with proliferating epithelium in the centre. The tubal epithelium is disorganised and represented by granulation tissue: "giant-cell systems" are numerous in the tube wall.

The adhesions to other organs in tuberculous salpingitis may be very intimate, and the bowel is readily injured during the removal of the tubes.

Salpingitis of Intestinal Origin.—Such lesions seldom result in extreme damage to the tube. The infection is generally from the appendix, less frequently from an appendix-epiploica. In these infections the abdominal ostium usually remains patent, or can be easily rendered patent, in spite of there being some thickening of the fimbriæ. After the appendix is removed the tube returns to normal, but resection of the tube is occasionally necessary (p. 1129). Sterility, the result of old appendix trouble, is by no means uncommon (p. 821).

CLINICAL FEATURES.—Backache and pelvic discomfort are present in most cases, and the latter may increase, on occasions, to severe abdominal pain. The onset of these symptoms following a febrile puerperium is a common history. In gonorrhœal cases the history is not always so definite. The latter infection should be suspected when pelvic uneasiness and leucorrhœa develop shortly after marriage, and especially where there is a history of burning pain on micturition. In such cases inquiry should be made of the husband as to whether he has suffered from venereal disease.

Premenstrual pain and menorrhagia are usually present, but they occur in many other pelvic lesions. Such general symptoms as headache, digestive disturbance and anæmia are often present. *But the most characteristic feature of chronic salpingitis is recurrent attacks of abdominal pain of variable severity.* In the type with sclerosed tubes, the attacks may amount only to pelvic discomfort.

The recurrent attacks of abdominal pain in the earlier stages of the disease are often associated with a rise of temperature to 101° , or even 103° ; but when the condition has been long established, the febrile disturbances may be less marked. The attacks do not recur at regular intervals. They vary in intensity from exaggerated discomfort to acute abdominal pain requiring fomentations and sedatives for their relief. Pain is usually referred to the lower abdomen: but in most cases it appears to be more marked on one side than on the other, and the same side remains the more affected at each attack. During the attack there is abdominal rigidity, more marked on the more affected side.

These recurrent attacks are not due to a renewed activity of the inflammatory process inside the tube. If the patient, during the attack, is subjected to abdominal operation it will be observed that the peritoneum covering the tube is very much injected, while collections of pus may be found around the tubes. The "flare up" arises from infective foci in cellular tissue (p. 1031) or from the adherent bowel, and occurs when the local resistance is lowered by constipation, exhaustion, etc.—it is a *perisalpingitis*.

It should be borne in mind, therefore, that chronic salpingitis may be encountered during (a) a quiescent phase, (b) during an acute or active phase.

PHYSICAL EXAMINATION.—Differentiation of the pelvic structures in salpingitis is in many cases (especially during the acute phase) so difficult as to require an anæsthetic.

In most cases the fundus is retroverted and fixed ; where the tubal distension is great, the fundus may be pushed forwards. Fixation of the retroverted fundus is of first importance in the diagnosis of inflammatory lesions of the adnexa ; fixation always suggests pelvic infection.

On each side of the uterus, and located behind it, will be found an irregular mass of variable size, usually greater on one side than on the other. These swellings consist of the matted tube and ovaries. The swellings are tender to touch, particularly during attacks of perisalpingitis and during premenstrual congestion ; in long-standing cases they may be quite insensitive. *Rectal examination* permits a very accurate differentiation of the retroverted fundus and distended tubes because the finger can be passed up beyond the pelvic masses. Indeed it is often possible to make a more exact diagnosis of the condition by bimanual rectal than by bimanual vaginal examination (p. 114).

DIFFERENTIAL DIAGNOSIS.—The diagnosis of chronic salpingitis may be difficult in both the acute and the quiescent phase.

(a) *The Acute Phase.*—Here the patient's past history is of the greatest importance in differential diagnosis. Acute appendicitis may resemble the acute phase of a chronic salpingitis most closely : in the former the onset is usually more sudden, and the pain and rigidity more localised. *Exact diagnosis is of the utmost importance, because, while appendicitis requires immediate operation, the salpingitis in the acute phase should be treated expectantly.* If, after an examination under an anæsthetic, appendicitis cannot be excluded, the abdomen should be opened without delay. An inflamed appendix should be removed at once ; but for choice a pyosalpinx should not be removed in the acute phase.

A small ovarian cyst, hydrosalpinx or pedunculated fibromyoma, in which torsion of the pedicle occurs, may give rise to very acute pain. But in these conditions the swelling is better defined in outline, is unilateral, and is very tender to touch. Furthermore, there is little, if any, pyrexia with these complications, whereas pyrexia is usually pronounced in chronic salpingitis in the acute phase.

Ectopic pregnancy may be difficult to exclude. Here the history given by an intelligent patient is of the utmost assistance. The ectopic swelling is unilateral and very tender to touch ; the menstrual history, when definite, is characteristic (p. 350). Pyosalpinx, however, may also be unilateral, may be at times tender to touch, and may cause further confusion because of its frequent association with uterine hæmorrhage (p. 353). The differential diagnosis may therefore be difficult in some instances. The leucocyte count and sedimentation rate may help one to exclude a tubal pregnancy, as does also a marked rise in temperature. Puncture of the posterior fornix by a trocar may be useful in determining whether the collection in the pouch of Douglas is pus or blood.

Other acute intestinal lesions—*e.g.* diverticulitis—may resemble the acute phase of chronic salpingitis.

While exactness of diagnosis should always be aimed at, most important is it that no condition demanding immediate abdominal section should be overlooked or treated by purely medical remedies.

(b) *Quiescent Phase*.—In most cases the fundus is central and the tubes lateral, but where the uterus is enlarged and tender it may be difficult to differentiate a simple backward displacement of the uterus from this displacement associated with adnexal inflammatory lesions. The crucial point is that, in the latter condition, the fundus is usually fixed. The swellings on both sides of the uterus may be singularly insensitive to pressure; they are fixed and irregular in outline and generally one is larger than the other.

Small ovarian tumours do not cause confusion unless they are adherent in the pelvis. The ovarian tumour is usually unilateral, seldom tender, and not often associated with much general disturbance. But an infected cyst is hard to distinguish from a pyosalpinx—it may be suspected if the outline of the swelling is very clearly defined.

The ordinary types of fibromyomata are easily identified; sometimes smaller tumours in the rectogenital space or adherent to the pelvic peritoneum (endometrioma) may very closely resemble sclerosed tubes.

The usual varieties of ectopic gestation are easily distinguished. The ectopic sac is practically always unilateral, but the pyosalpinx rarely so; the ectopic sac is, as a rule, more tender than the inflamed tube. The clinical history is of the greatest value. In the case of a half-absorbed pelvic hæmatocele there may be irregular thickenings and fixation of fundus in pouch of Douglas and the condition may resemble a chronic salpingitis. Generally speaking a careful consideration of the history will clear matters up.

Chronic appendicitis may be differentiated by its unilateral character; an inflamed appendix, low in the pelvis, may be very hard to distinguish from an inflamed tube. Where an appendix has ruptured and an inflammatory mass exists in the pelvis, it may be extremely difficult to diagnose the source of the lesion. Again, the clinical history is very helpful.

TREATMENT.—Where chronic salpingitis is well established and has become associated with persistent discomfort or pain, permanent relief can only be secured by operation. Chronic inflammation of the tubes is a much more troublesome and intractable lesion than infection of the pelvic cellular tissue. The latter may respond completely to rest, glycerine tampons, douching, fomentations, light baths, X-rays (modified dosage) (p. 1049). In chronic salpingitis treatment on these lines may relieve the pain temporarily, but seldom effects a cure. This conservative treatment should nevertheless be given a complete trial.

In cases with sclerosed tubes in which the only symptom is sterility and occasional pelvic discomfort, periodic courses of treatment

by the methods mentioned above may enable the patient to continue in satisfactory health without an abdominal operation. In this type of case insufflation of the tubes should be carried out in order to determine if either is, or can be, rendered patent. The manner of carrying out this particular investigation is described elsewhere (p. 821).

In the graver examples of this disease in which recurrent attacks of acute inflammation occur, it is desirable that operation should not be too long delayed. With each attack the adhesions of the tubes to the surrounding structures become more intimate, while the patient's general health becomes progressively impaired. There is nothing to be gained by postponing operation in this type of case.

In cases where there is a definite pyosalpinx the tubes should be removed. It was customary in the past to conserve the ovaries as far as possible with the view to prevention of an acute menopause. With the additional experience of recent years, gynæcological surgeons are less inclined to leave the ovaries, or portions of ovaries, unless they are satisfied that they are in a healthy condition or will become so after the tubes have been removed. Many operators now favour complete removal of tubes, ovaries and uterus if these organs are very seriously damaged. With the endocrine preparations now available the discomforts of an acute menopause can be held in check.

The various operations for this condition are described in Chapter LVIII.

TUBO-OVARIAN CYSTS

In such cysts the lumen of the distended Fallopian tube communicates with a cystic cavity in the substance of the ovary. In some

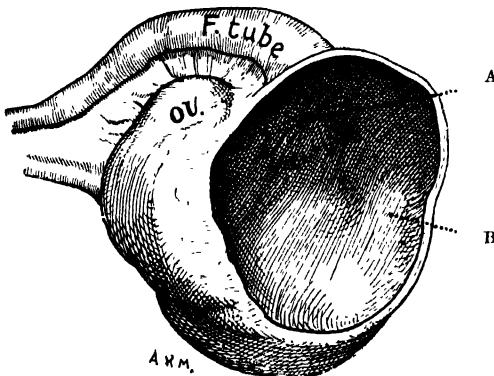


FIG. 415.—Tubo-ovarian Cyst.

A. Fimbriae of Tube. B. Interior of Cyst of Ovary.

cases the wall of a hydro-salpinx has become adherent to a cystic ovary and free communication been established between the two cavities. In another type there is no sign of any preceding inflammatory lesion; the condition seems to have arisen as a developmental error, in which the ovary has been surrounded by a peritoneal sac forming a *tunica vaginalis*, into which the ostium of the tube opens.

This exclusion of the ovary from the general peritoneal cavity is found in some of the lower animals. In these instances the tubal fimbriae can be identified on the wall of the cystic ovary (Fig. 415).

This condition may be associated with the clinical signs of chronic

salpingitis, or may be absolutely without local symptoms, the exact nature of the condition being discovered at operation. When the abdomen is opened, an attempt should be made to save the Fallopian tube, and some ovarian tissue. This may be possible if no extensive inflammatory lesions are present.

CYSTS OF THE FALLOPIAN TUBES

A variety of small cysts may arise in the wall of the Fallopian tubes, but they are of little clinical importance.

On the surface of the tubes themselves there may be little collections of lymph, forming subperitoneal blebs; sometimes these serous collections are definitely walled off as tiny cysts. The commonest form of tubal cyst is the so-called *hydatid of Morgagni* (Fig. 408)—a small spherical or oval cyst, resembling a small white grape, at the outer end of the tube. It is due to cystic changes in one of the tubal fimbriæ, and, as these fimbriæ are developed in the region of the pronephros, this hydatid has been classified by morphologists as a pronephric cyst. It has little clinical significance. It is well to bear in mind, however, that torsion of the cyst occasionally occurs. The symptoms are similar to but less severe than with torsion of an ovarian cyst.

Again, in chronic salpingitis, a small portion of the mucous membrane may become walled off from the lumen of the tube, and by the continued secretion of the epithelium give rise to a tubal cyst. Such retention cysts may occur as tubal diverticula without any inflammatory changes being present. Cystic formation in the region of the tube may occur in echinococcal invasions (p. 881).

SOLID TUMOURS OF THE FALLOPIAN TUBES

Myoma and Adenoma.—Tumours of a fibromyomatous type are rare, and may be intramural or pedunculated. If conservative surgical measures are employed, care should be exercised to damage the tube lumen as little as possible.

Adenomyomata are also rare; they very closely resemble the thickening of the tube wall found in "salpingitis nodosa" (p. 957).

Papilloma.—This epithelial tumour usually arises in the ampulla of the tube. By its growth it may distend the tube very much, and the lumen may become closed at one or both ends. There is a copious serous secretion from the tumour surface which, if the uterine end of the tube is patent, may escape through the uterine cavity in the same manner as in a "hydrops tubæ profluens" (p. 1030).

The tumour may grow rapidly and, as in most epithelial growths of this type, there is a tendency to malignancy. While the epithelium covering the tumour is usually single-layered, and the stroma made up of fine connective tissue (presenting no evidence of an inflammatory

origin), the lesion in many instances has been preceded by an old-standing chronic salpingitis.

The exact diagnosis of this tumour is difficult—it can hardly be distinguished clinically from an ovarian neoplasm. The association of such a swelling with the intermittent discharge of yellowish, mucus-like material from the vagina, and coincident attacks of pain, may give an indication of the condition. The discharge may be found to contain separated branching epithelial processes. If the tubal contents are discharged into the abdomen, these may attach themselves to the peritoneum and continue to grow and cause ascites.

The tumour should be removed with the tubes and ovaries because of the risk of malignancy.

Malignant Papilloma.—In a certain number of cases the simple

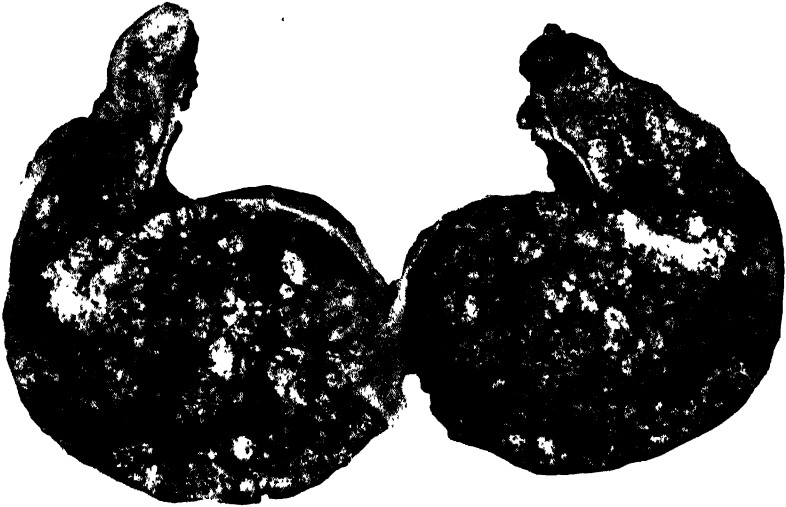


FIG. 416.—Malignant Papilloma of Tube.

The tube has been cut open. The other tube was not affected.

papilloma described above shows malignant changes. The epithelium proliferates and burrows through the tube wall. The growth is very active and irregular. Perforation of the tube, with extensive ascites, is an early event in the malignant development of this tumour.

Adeno-carcinoma.—(a) *Primary.*—This tumour is rare and seldom occurs before the menopause. While it may develop from any part of the tube, it has been most commonly found to originate in the ampulla. It is usually bilateral; evidence of a previous salpingitis has been found in many cases. Microscopic examination may reveal either irregular glandular alveoli or solid masses of epithelial cells. The tube becomes distended by the soft, greyish tumour, and perforation of the wall may occur, with a subsequent rapid spread throughout the pelvis and abdomen. The tumour is seldom diagnosed as of tubal

origin until operation. A watery, blood-stained vaginal discharge is generally present; but this is also a feature of the much commoner condition of adeno-carcinoma of the uterus. Pain in the lower abdomen, ascites, distension and cachexia are the other clinical signs. Bimanual examination reveals a palpable tumour behind and to the side of the uterus—occasionally the condition is bilateral.

The prognosis is grave. Complete removal of tubes, ovaries and uterus, together with the lymphatic glands in the pelvis and lower abdomen, should be carried out when the condition has been diagnosed sufficiently early to make such an extensive operation worth while. Deep X-ray therapy is the alternative.

(b) *Secondary*.—The tubes may be affected by direct extension in cases of advanced carcinoma of the body of the uterus. Metastases in the tubes seldom occur in carcinoma of the cervix.

Sarcoma.—This is a very rare tumour which may originate in the fibromuscular wall of the tube.

Chorionepithelioma.—This condition is very rare. It may appear either as a sequel to a tubal pregnancy or in cases where the pregnancy has been intrauterine. In the latter case the growth must be considered as a metastasis, similar in nature to those found in the vaginal wall. The tumour grows rapidly, but the diagnosis is seldom made before the abdomen is opened. A strongly positive reaction to the Aschheim-Zondek test will be present (Chorionepithelioma of Uterus, p. 984).

In the surgical removal of the growth, unless the operator is certain that the uterus is not implicated, that organ should be removed with the tubes and the ovaries. The prognosis is grave, as the lesion is usually far advanced before it is suspected and operated upon.

Endothelioma and Perithelioma.—Such tumours have been described as rare lesions of the tubes. Here again an exact diagnosis is only possible after microscopic examination of the removed growth.

HÆMATOSALPINX

This condition—viz., an accumulation of blood in the Fallopian tube—may be the accompaniment of a variety of lesions described in this and other chapters. It may develop as a result of atresia of the vagina or cervix (p. 777). Then it may result from a tubal mole (p. 343) which has disintegrated. It is not infrequently associated with fibromyomata of the uterus (p. 937) and endometriomata.

The clinical features are those of salpingitis, but may not be pronounced.

In most instances the tube or tubes have to be sacrificed along with the ovary; but occasionally conservative salpingostomy and resection of ovary (p. 1124) may be employed if the tube is not seriously affected.

CHAPTER LII

DISEASES OF THE PELVIC PERITONEUM AND CONNECTIVE TISSUE

Peritonitis—Cellulitis—Hæmatocele and Hæmatoma—Endometrioma---
Tumours of Rectogenital Cellular Tissue

PELVIC PERITONITIS

PELVIC PERITONITIS is the term used to describe an infection of the peritoneum which is localised in the pelvis. Years ago a special term—*perimetritis*—was introduced to describe this condition, but it has disappeared from general usage and the older term, the heading of this section, is again universally employed. The infection may have originated in the abdominal cavity above, the pelvic peritonitis being the end result ; but much more frequently the infection is pelvic from the commencement.

Ætiology.—While *appendicitis* is the commonest cause of infection of the pelvic peritoneum if men, women and children are included, it drops down to a lower place if we consider women only. In women between the ages of eighteen to fifty puerperal and gonorrhœal infections assume first and second places ; then comes appendicitis. Tuberculous infection is less common ; while in a very small number of cases infection comes from the colon (appendices-epiploicæ). Peritonitis is never idiopathic ; it results from an infection in an abdominal or pelvic organ, or borne by the blood-stream as in the case of tubercle. There are, however, distinctive features about pelvic peritonitis to warrant its being considered as a clinical entity, although in reality it is a symptom not a disease *per se*.

Puerperal Infection.—Under this heading are included not only the infections which arise during labour at term but also those associated with abortion. These have been discussed in Chapter XXXVII.

Of the cases which do not terminate fatally a few may end in complete local recovery ; but the great majority finish up with uterus, tubes and ovaries less or more permanently injured, persisting functional disorders, and impairment of general health. Puerperal infection is responsible for nearly all the cases of chronic subinvolution of the uterus and 50 to 60 per cent. of the examples of pyosalpinx and salpingo-oöphoritis. An encysted peritonitis is an occasional end result. This condition, as we have seen, may closely simulate an ovarian cyst (p. 1021).

Gonorrhœa.—The ideal soil for the gonococcus is the mucous

membrane of the uterus and the Fallopian tubes (p. 869): it does not flourish when it reaches the peritoneal cavity. A pure infection by the gonococcus may cause pyosalpinx or salpingo-oöphoritis with matting of the tubes, but it does not cause a virulent peritonitis. Should such a condition develop, it is because a streptococcal or staphylococcal infection has been superimposed on the original gonococcal infection. These secondary organisms are able to thrive more easily because of the damage primarily wrought by the diplococcus.

Tubercle.—Tuberculous peritonitis has been already considered (p. 880).

Appendicitis.—Apart from the acute general peritonitis which commonly follows rupture, an infected appendix may be associated with either an acute or a chronic pelvic peritonitis. In the former event the clinical history and the physical signs make the diagnosis easy, but in the latter the condition may be difficult to distinguish from (a) a chronic salpingitis, (b) a right-sided ectopic pregnancy, (c) an ovarian cyst with twisted pedicle. An accurate diagnosis in respect to these conditions is of the utmost importance; because while appendicitis, ectopic pregnancy and an ovarian cyst with twisted pedicle require immediate operation, salpingitis is best treated by rest, douches, etc., until the acute stage has passed (p. 1034).

Most difficult to unravel may be cases in which the inflamed appendix sinks into the pouch of Douglas and forms an abscess, with tubes and ovaries secondarily involved, the mass being indistinguishable from a salpingitis, except by the clinical history or when the abdomen is opened at operation. Thus appendicitis may result in serious injury being done to tubes and ovaries (*vide* Sterility), although seldom to as grave a degree as puerperal or gonorrhœal infection inflicts.

Diverticulitis.—This condition, if affecting the sigmoid flexure and pelvic colon (rectum), may in its acute phase closely resemble an appendicitis, only, naturally, the physical signs are more especially localised to the left iliac fossa. Here again the condition may simulate or be simulated by left-sided salpingitis, tubal pregnancy or ovarian cyst with twisted pedicle.

The gynæcologist most commonly encounters the condition in its chronic form when the inflammatory mass (bowel, tube, ovary) felt in the left side of the pelvis may closely resemble a malignant ovarian tumour or a carcinoma of rectum. A barium meal or barium enema followed by a radiograph clears up the question of diverticulitis.

Other Causes.—The hæmatocele resulting from an ectopic pregnancy usually remains sterile, but organisms may penetrate from the bowel and give rise to a pelvic peritonitis (p. 355).

Then peritonitis may follow a major operation on uterus, ovaries, tubes; and occasionally even from a curettage if virulent organisms have been introduced during the operation. Peritonitis is particularly liable to occur if the uterus is curetted for any septic condition—

(a) retained placenta or membranes ; (b) incomplete septic abortion ; (c) septic condition of uterus associated with advanced carcinoma of uterus.

Uterine and ovarian tumours are sometimes complicated by pelvic inflammatory lesions from circulatory disturbances, such as torsion of the pedicle or impaction—this type of peritonitis is usually mild, and the adhesions can be easily separated. Occasionally organisms penetrate the tumour from the bowel or from the uterus, when extensive inflammatory changes may occur in the tumour which may even proceed to abscess formation.

Clinical Features.—The onset may be associated with sickness, vomiting, a rise of temperature and sometimes a rigor. Pain is severe, is localised in the lower abdomen, and is increased by pressure in the iliac fossæ. Abdominal rigidity may be present at a level well above the pelvic brim. This rigidity is more marked on the right iliac fossa with appendicitis and in the left iliac fossa with diverticulitis. Even when the infection spreads upwards from vagina and uterus, as pertains in puerperal and gonorrhœal infections, tenderness and rigidity may be more pronounced on one side ; because while both adnexa are generally affected one may be more severely involved. There is generally some distension with tympanites. Respirations are more frequent and shallow : the tongue is dry and furred. The patient lies in bed with the knees flexed, avoiding all movement. In a considerable number of cases the infection is lethal ; but the process may subside and a slow recovery (seldom complete) takes place, and many cases are rescued by operation.

On vaginal examination the vault appears full and very tender. Pressure on the cervix causes great pain. The pouch of Douglas appears filled with some semi-solid substance ; but nothing definite can be made out, as all the pelvic organs are implicated. Should abscess formation occur, the swelling in the posterior fornix becomes elastic and sometimes even fluctuant. If spontaneous evacuation occurs it is usually into the bowel, seldom into the vagina. There is always some involvement of the cellular tissue associated with the peritonitis, but pelvic cellulitis as a special entity is considered in the next section.

Treatment.—The treatment of a case of pelvic peritonitis requires very careful consideration, and depends upon the source of the peritonitis, the extent of the involvement of the pelvic viscera, and the presence or absence of a collection of pus in the pelvis.

Puerperal Origin.—In the puerperal type we have seen that the peritoneal lesion may clear up very well, though damaged tubes and ovaries may remain. In few puerperal cases is operative treatment advisable during the acute or subacute phase.

There are, however, a few puerperal cases in which more radical treatment has to be carried out. When the patient is going rapidly downhill in the early days of the puerperium in spite of recognised treatment (p. 646), or when, after two or three weeks of a less

virulent infection, there is no sign of improvement, it may be advisable to remove the uterus, tubes and ovaries or to drain the pelvis through the vagina (p. 647).

When the acute phase has passed and the lesion has settled down to a chronic pyosalpinx or a salpingo-oöphoritis, treatment depends on the condition of these organs (p. 1035). Recrudescence of the localised peritoneal lesion occurs in the form of perisalpingitis, and the significance of this condition has already been described (p. 1033).

Gonorrhœal Origin.—As has been already indicated, the gonococcus itself is seldom a cause of marked pelvic peritonitis. Such a complication is due to superimposed more virulent pyogenic organisms. The treatment of gonorrhœa is discussed elsewhere (p. 870).

Appendical Origin.—Abdominal section should be performed immediately. If drainage is necessary it should be carried out through the loin, so that the ovaries and tubes may not become secondarily infected, as is more likely to occur if vaginal drainage is employed.

Where a collection of pus is present deep in the pelvis, either in an acute case or in an old-standing case, drainage can be very easily established through the posterior fornix. Later, when the patient has recovered, the abdomen may have to be opened and adhesions between individual organs broken down. By this means serious permanent disability to tubes and ovary may be prevented.

Particularly serious are cases in which a suppurating appendicitis occurs during pregnancy (p. 241) or the puerperium (p. 658).

Other Cases.—An infected pelvic hæmatocele should be drained *per vaginam*, and this is sufficient treatment in most cases (p. 358); in a few the persistence of symptoms may require a subsequent laparotomy.

Where the peritonitis is associated with large tumours the abdomen should be opened and the causal lesion dealt with: vaginal drainage may require to be established at operation. In the case of an ovarian abscess impacted in the pelvis, it may be better treatment to drain the contents through the vagina and deal with the cyst through the abdomen at a later date.

Pseudomyxoma Peritonei.—In the exploration of the pelvis a collection of straw-coloured, tenacious, jelly-like fluid may be found closely adherent to the peritoneum. In most cases it is associated with an ovarian cystoma (p. 1000) although it has been found in cases of appendicitis; inflammatory reaction is slight.

PELVIC CELLULITIS

Inflammatory lesions of the cellular tissue of the pelvis have been understood for a much longer time than pelvic peritonitis—our more exact knowledge of the latter has grown with the development of abdominal surgery. In the old descriptions of the condition, “phlegmon” was the term used; later the term “parametritis”

was introduced, indicating a lesion of the cellular tissues round the uterus. Now the designation *pelvic cellulitis* is recognised as the most accurate, in that the lesion may affect any part of the cellular tissue of the pelvis.

The cellular tissue of the pelvis is involved *secondarily* in most of the infective lesions already mentioned—*e.g.* salpingitis, salpingo-oöphoritis, and even occasionally appendicitis. There is, however, a *primary* infection of the pelvic cellular tissue which remains confined or practically confined to that tissue and runs a definite clinical course (p. 647). In such the remaining pelvic structures, particularly the tubes and ovaries, usually escape serious damage.

Ætiology.—Pelvic cellulitis occurs when infection extends into the pelvic cellular tissues as a result of some injury to the walls of upper vagina and cervix. In most instances the cervix or vaginal wall has been lacerated during parturition. On occasions the injury has been done during dilatation of the cervix or curettage. And still more rarely infection has extended from a sloughing fibroid or an ulcerating carcinoma. But if associated with these neoplasms the cellulitis is seldom extensive; more commonly the tubes are involved.

So close is the association between injury to the cervix and pelvic cellulitis that such a history may be of great assistance in diagnosis. The organisms usually found are varieties of anaerobic streptococci, staphylococcus and *Bacillus coli*. In most cases the infection is mixed. The gonococcus is never the primary agent in the production of pelvic cellulitis, because it spreads along the surface of mucous membranes; where cellulitis occurs in the train of a gonorrhœa, it is due to a secondary infection by streptococcus or staphylococcus.

Pathological Anatomy.—The localisation and spread, together with the physical signs, of pelvic cellulitis depend upon the anatomical relationships of the cellular tissue in the pelvis, which has already been described (p. 34). This tissue is continuous with the subperitoneal cellular tissue of the abdomen, but is shut off by a very complete diaphragm from the cellular tissue of the perineum. The only channels through which the pelvic tissue communicates with the cellular tissues at lower levels are the exits of the femoral ring, the sacro-sciatic foramen and the obturator foramen; but it is seldom that a pelvic cellulitis spreads through these channels.

The distribution of cellular tissue is not uniform. Over the upper portion of the anterior surface of the uterus and right down to the level of the internal os on the posterior surface it is very scanty, as the peritoneum is adherent to the muscle tissue. The same scantiness exists over the upper surface of the Fallopian tubes and also on that part of the anterior surface of the sacrum which is not covered by the bowel. There is considerably more cellular tissue between the bladder and the uterus, between the layers of the broad ligaments and in utero-sacral ligaments around the rectum. The greatest accumulations,

however, are found in the space of Retzius (between the anterior wall of the bladder and the symphysis pubis), and at the base of the broad ligament on each side of the cervix where it forms the very dense and important paracervical tissue. As the paracervical tissue extends down as far as the upper third of the vagina it is easily infected in tears of cervix or vaginal vault; it is in this locality that cellulitis most commonly commences.

While injury to cervix or uterus in the non-gravid from dilatation or curettage may be followed by cellulitis, should infection occur, the cellulitis is seldom as extensive as where it follows a parturition.

During pregnancy the cellular tissue becomes increased in amount, more open in texture and more vascular; this explains why infections in the puerperium, following trauma at parturition, extend so rapidly. In the typical case of puerperal cellulitis the infection is at first limited

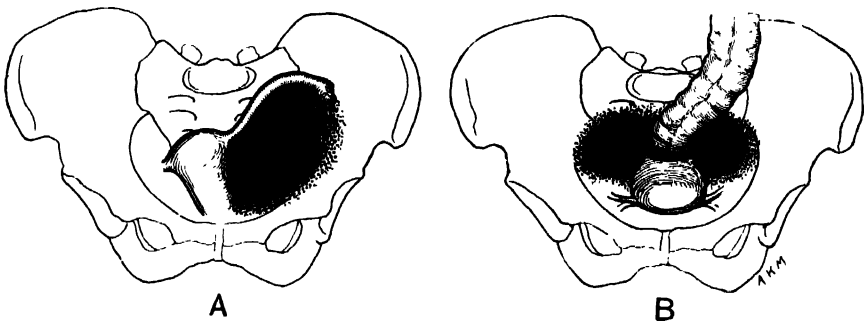


FIG. 417.—Diagrammatic Illustration of Pelvic Cellulitis.
A. Lateral Effusion. B. Posterior Effusion.

to one, or is more pronounced on one side. That side is more often the left than the right, because laceration of the cervix occurs more commonly on the left side (p. 596); possibly, also, the presence of the pelvic colon may influence the greater frequency of left-sided cellulitis.

The effusion tends to travel outwards towards the pelvic wall, then upwards and forwards along the pelvic fascia; in consequence an indurated mass may be felt closely applied to the bony wall along the pelvic brim (Fig. 417). At other times the effusion extends to the other side of the cervix and along the utero-sacral ligaments to the tissue around the rectum. Again, it may extend to the loose tissue occupying the space of Retzius and reach the anterior abdominal wall.

In the majority of cases the stage of suppuration is never reached; the effusion is absorbed and no trace of the lesion is left. A little induration may remain, but only in a relatively small number of cases; ultimate cicatrisation of the affected tissue may draw the cervix towards that side, and cause also fixation of the uterus.

In a number of cases, however, the inflammatory process does not stop at effusion, but goes on to suppuration and abscess formation. In this eventuality the upward extension of the inflammatory process continues, and a line of induration develops parallel to and above Poupart's ligament—the abscess commonly points in that position. The extension of the infective process may travel along the infundibulo-pelvic ligament and along the course of the ovarian vessels, right up to the perirenal area, where an abscess may develop. In a few cases "pointing" occurs towards the rectum an inch or two above the anus or towards one vaginal fornix. Unusual situations for the pointing of such abscesses are Scarpa's triangle, the buttock and the ischio-rectal fossa; in these cases the spread has occurred through the exits already mentioned (p. 1044).

Spontaneous evacuation occurs much less frequently now than in former days, because the gynaecologist usually anticipates this by incision and drainage. But there still occur instances in which a large discharge of pus takes place *per rectum*.

In the type which appears above Poupart's ligament the process travels slowly, and weeks may elapse between the initiation of the infection and pointing of the abscess.

Clinical Features.—While the features of a typical puerperal cellulitis, once it is established, are characteristic, it may be difficult to differentiate the lesion in the early stages from other infective conditions. The history of a curettage or the presence of an infected neoplasm suggests the possibility of this complication where a cellulitis arises apart from the puerperium.

In the Puerperium.—The temperature and pulse are not quite satisfactory, though the patient may not show signs of serious illness (p. 647). Mild, subjective symptoms may be present, such as headache, malaise or depression. The acute stage is not reached until the end of the first or well into the second week; the patient may then have a rigor, followed by a rapid pulse and a high temperature. Pain, not usually of a very severe type, may be complained of on the affected side.

Vaginal examination may reveal a uterus only slightly larger than the normal for the stage of the puerperium; attempts to move the uterus by pressure on the cervix cause pain. A feeling of fullness may be appreciated at the base of the broad ligament on the affected side (most commonly left side as stated). It may not be until a few days later that a distinct effusion can be felt, pushing the uterus to the other side. In the case of cellulitis the effusion gives the impression of being associated with the anterior rather than the posterior part of the pelvis; the reverse is the case in the exudate of a peritonitis.

After a Curettage.—The incidence of a cellullitic infection is usually much earlier. Within two or three days a rigor with a rise of

temperature and pulse occurs, and very soon an effusion can be recognised on one side. As stated, the effusion seldom assumes the dimensions of an effusion following a puerperal infection.

In association with this infective effusion, signs of the involvement of other organs may occur. Constipation, with painful defæcation, may be present. A mild cystitis is very frequent. We have seen what a large amount of cellular tissue surrounds the bladder, and from this the vesical mucous membrane may become infected. The pelvic and femoral veins may become thrombosed, but this is a fairly rare complication; the resultant swelling of the leg is seldom so extensive as in "phlegmasia alba dolens" (p. 648).

The general condition of the patient remains unsatisfactory, but in most cases, with the spontaneous arrest of the process and the absorption of the exudate, the disturbing signs disappear. When pus formation occurs the temperature is of a high, swinging type, but the pulse seldom shows such marked disturbance as the temperature. Sweatings are frequent, and the usual signs of septic absorption appear; the patient becomes thin and emaciated.

Prognosis.—Fortunately, the prognosis in a typical pelvic cellulitis is good. In spite of the large effusion and the high, swinging temperature death very seldom results; and septicæmia and pyæmia rarely occur. When the pus has been evacuated in the suppurative type, the sinus usually closes up soon and few traces of the lesion may be left. In many cases the convalescence is prolonged, but where thorough treatment is carried out the prospects of complete recovery are very good. There may be some displacement of the cervix to one side, resulting from cicatrisation, or it may be drawn upwards and backwards by the cicatrised utero-sacral ligaments, thus producing an acquired acute antelexion. In the latter type, pressure on these ligaments from the vagina causes pain, and the patient may suffer from dyspareunia (p. 812).

When a case in which there has been an undoubted cellulitis does not clear up it is almost certain that other organs are involved (*e.g.* Fallopian tubes) which are responsible for the persistence of the symptoms.

Differential Diagnosis.—There are few conditions which simulate pelvic cellulitis. In the acute stage the history of a recent parturition or of an operation on the uterus, or the presence of a tumour with the local signs of infection, is diagnostic. When the stage of fever is over, diagnosis from physical signs may be more difficult, though a careful investigation of the clinical history will usually be most helpful.

The condition which most frequently causes confusion is pelvic peritonitis of tubal or appendical origin. In the subacute stage it may be difficult to determine whether the pelvic infection is limited to the cellular tissue or involves the tubes also. A unilateral lesion is

usually of cellular tissue origin, whereas a bilateral lesion is usually associated with tubal infection.

The following differential summary may be helpful :—

	<i>Pelvic Peritonitis.</i>	<i>Pelvic Cellulitis.</i>
Ætiology.	Puerperal infection, especially of body of uterus; gonorrhœa, ruptured ectopic pregnancy, tubercle, appendicitis, diverticulitis, etc.	Puerperal infection, especially of cervix, curettage, etc.; but not gonorrhœa.
Symptoms.	Pain (early)—very pronounced in early stage, less in chronic condition: defæcation (painful).	Begins about tenth day of puerperium, sooner if it follows curettage; pain, but not extreme.
Vaginal examination and nature of swelling.	Behind uterus; elastic at early stage.	Side of uterus, although sometimes surrounds cervix; indurated at first, then soft if abscess forms.
Rectal examination.	Effusion between rectum and uterus.	Effusion may surround rectum like horseshoe.
Progress.	Prognosis should be very guarded.	Good, almost never fatal.
Course of disease.	Rarely a spontaneous cure; pus sometimes empties into bowel: sterility very frequently follows.	Effusion often absorbed spontaneously; if abscess points, generally above Poupart's ligament; sterility rarely follows.

Pelvic neoplasms arising from the ovary or uterus, which happen to be imbedded in the broad ligament, especially where the tumour has become infected, may closely resemble a pelvic cellulitis. In point of fact, in such cases there is always some secondary cellulitis. A careful investigation of the clinical history is of great importance, but in many cases an examination under a general anæsthetic will be necessary before a diagnosis can be established. The outline of an ovarian or uterine neoplasm is usually more easily defined, except where there is pronounced infection round the tumour. Rectal examination in these cases may give a much better opportunity of determining the relationships and origin of the pelvic swelling.

The same applies to ectopic pregnancy, especially where it has made its way between the folds of the broad ligament, or given rise to a pelvic hæmatocele. The history, when definite, is of the utmost value in diagnosis. Most difficult are the cases in which the ectopic pregnancy has been mistaken for an intrauterine abortion, and the effusion in the pelvis is regarded as due to infection.

Treatment.—The treatment of sepsis in the puerperium and the use of sulphonamides are considered in Chapter XXXVII.

When the condition is definitely a cellulitis, hot vaginal douches (108° to 110°) should be given twice daily. Vaginal tampons soaked in glycerine and ichthyol (6 per cent.) should be inserted at night and removed in the morning, thereby withdrawing large quantities of fluid from the tissues. While these tampons are always very beneficial in the subacute stage, they sometimes cause too much discomfort in the acute stage. Douching and tamponage should be continued for fourteen days, stopped for seven days, and then resumed only when they seem necessary. The diet should be carefully chosen, and should be simple and easily assimilated. Elimination should be supervised. Tonics containing iron and arsenic help recovery. One of the best preparations for the purpose is Syrup of Iodide of Iron.

Great help in the relief of discomfort and in the absorption of the exudate is obtained by the application of heat to the abdomen. Turpentine and laudanum stupes may be used, but such a preparation as antiphlogistine is even more useful. Heat may be applied over the whole pelvis by the use of a closed cradle fitted with electric bulbs. This last method hastens the absorption of the exudate, but if the applications are too prolonged, they may prove exhausting to the patient—fifteen to twenty minutes' application twice daily is adequate. X-rays (modified dosage), if employed, should be used with great caution as injury may be done to the ovaries.

It is most important that the patient should be kept in bed until the effusion has completely subsided—neglect of this precautionary measure may lead to an acute recurrence. Recovery is often slow.

Surgical Treatment.—No operative treatment should be employed until there is definite pus formation.

The incision should be made at the most dependent part of the abscess, and the best site may be the posterior vaginal fornix. Where the abscess is larger, and points above Poupart's ligament, incision there is preferable. The pus collection may have to be attacked from other directions, for example, through the anterior fornix between bladder and uterus, or through the rectum after overstretching the sphincter. After the pus has been evacuated a rubber drainage tube should be inserted—gauze should not be employed for drainage.

Treatment of the ultimate displacements due to cicatrisation may be difficult, as incision of the cicatrised tissue is followed generally by a return of the contraction. In the case of contraction of the utero-sacral ligaments, if pelvic discomfort is not relieved by periodic courses of douching and tampons, it may be deemed advisable to open the abdomen, divide the cicatrised tissue and cover the incisions with peritoneum. But we have seldom seen much benefit result from attempts at improvement by surgical measures.

PELVIC HÆMATOCELE AND HÆMATOMA

A pelvic *hæmatocele* is a collection of blood in the pouch of Douglas—pelvic *hæmatoma* is an effusion of blood into the cellular tissue of the pelvis.

Pelvic Hæmatocele.—This condition results in most cases from an ectopic pregnancy (p. 354). On occasions it has resulted from hæmorrhage from a ruptured Graafian follicle, from rupture of a vessel on the surface of an ovarian tumour or a fibromyoma of the uterus, or an enlarged vein in the broad ligament. It may also develop in cases of atresia of the vagina or cervix, where the menstrual flow has regurgitated through the tubes (p. 777).

The treatment of this condition when due to ectopic pregnancy or a ruptured vessel, as mentioned above, is immediate abdominal section. In cases where there has been regurgitation of blood as a result of atresia of vagina (imperforate hymen) absorption generally occurs.

Pelvic Hæmatoma.—This condition also results most often from an ectopic pregnancy (p. 343). It may occur as a complication of the later months of an otherwise normal pregnancy and may simulate very closely “concealed accidental hæmorrhage” (p. 586), or from “spontaneous rupture of the uterus” during pregnancy (p. 598). It may occasionally arise apart from pregnancy if a large vein in the broad ligament should rupture. The condition has been already described (p. 606).

Endometrioma.—Such growths most commonly arise in the ovary (p. 1015). They may also develop in the pouch of Douglas from portion of endometrium engrafted on the peritoneum. *Endometriosis* is the generic term given to all growths containing endometrial tissue—chocolate cysts of ovary, small adenomata on surface of uterus in Douglas’ pouch or elsewhere in the pelvis (p. 954).

TUMOURS OF THE RECTO-GENITAL SPACE

Tumours of various types may occur in the cellular tissue between the reproductive organs and the rectum. All of them may be difficult to differentiate from intraperitoneal growths which have become anchored in the pouch of Douglas. In their removal special care must be taken to avoid injuring the bowel, as the bowel wall may be very closely incorporated with the tumour.

Adenomyoma.—These most interesting tumours have been already described (p. 957). They are usually very tender on pressure, and often cause dyspareunia (p. 812). As already mentioned, they may penetrate through vaginal fornix and simulate a malignant growth. They probably arise from some of the embryonic structures—relics of the Müllerian ducts. They may be removed either through the abdomen

or the vagina, according to their accessibility, or alternatively and preferably treated with radium (*vide* p. 958).

Fibromyoma.—Cervical fibromyomata are considered in Chapter XLVIII (p. 935). As a complication of labour they are referred to earlier (p. 549).

Cysts.—These may arise from the lower end of Gärtner's duct, as shown in the illustration (p. 899). Dermoid cysts are very occasionally found in this situation.

Sarcoma.—As a great rarity this type of malignant tumour may develop in this region, although it may be difficult to determine the exact site of origin.

PART XI
GYNÆCOLOGICAL OPERATIONS

CHAPTER LIII

INTRODUCTORY

Preparations for Operation—General Remarks regarding Surgical Technique—Postoperative Treatment

WE have deemed it advisable to introduce this chapter so that the beginner may learn the principles and the essential details of technique in gynæcological surgery.

1. PREPARATIONS FOR OPERATION

GENERAL PREPARATION.—Although operations vary in severity, it must be clearly understood that none can be undertaken without risks to the patient being incurred. The two great risks are from anæsthesia and from infection. *The danger from anæsthesia* can be reduced to a minimum by the thorough preparation of the patient beforehand, and by care exercised in the choice and in the administration of the anæsthetic.

The risk of infection—infinitely the greater of the two—is to be avoided by the careful preparation of the patient, the field of operation, sutures, ligatures, instruments and dressings, and of surgeons, assistants and nurses. The simplest operations may be followed by death if these details are not followed—for example, even the simple operation of curettage of the uterus may have a fatal termination.

Unless in cases of emergency, it is advisable that twenty-four to forty-eight hours should be allocated to the preparation of all patients prior to operation. The following are some of the details to which special attention should be directed :—

Bowels.—The bowels should be thoroughly evacuated, first of all by a purgative (preferably castor oil), then by two enemata to ensure that the lower bowel is well emptied. The castor oil, or other purgative selected, should be administered thirty-six hours or so before operation, and the last of the two enemata should not be given too soon before the operation. The patient should never be disturbed by enema on the day of operation. Too free purgation, and especially enemata, sometimes produce marked disturbance, such as faintness, sickness and mental depression. The patient should therefore be given a few hours' time to recover before the anæsthetic is administered and the strain of the operation encountered.

Diet.—During the twenty-four to forty-eight hours of preparation

the diet should be simple, and plenty of fluids, such as barley water, weak tea, glucose and orange juice should be given. Prolonged starvation predisposes to acidosis, but it is undesirable that the patient should have solid food in the hours immediately before the operation. A cup of soup or tea two hours beforehand is the last nutriment she should receive.

Kidneys.—It is important to secure good renal activity beforehand, for this undoubtedly lessens sickness and other complications which result therefrom.

Mouth.—Septic conditions of teeth, gums, etc., are often responsible for the parotitis, pulmonary disturbance, etc., which occasionally follow quite simple operations. It is therefore desirable that the mouth and teeth should be thoroughly cleansed and all septic stumps removed prior to operation. This is often difficult to arrange, especially in the case of hospital patients who give very little attention to their teeth and gums.

SEDATIVES.—Hyoscine and morphia ($\frac{1}{100}$ gr. of hyoscine, $\frac{1}{4}$ gr. of morphia) may be administered with advantage immediately before the operation. Undoubtedly, in a few cases morphia and hyoscine produce sickness, so that if patients have had previous experience of sickness from morphia it is well to substitute some other narcotic. Avertin per rectum is an excellent basal narcotic to be followed by gas and oxygen anæsthesia (*vide* p. 1059).

Routine Medical Examination.—This is an important matter to attend to, and we are inclined to think it does not receive sufficient consideration. The more ordinary disturbances which occasionally handicap patients and operator are bronchitis, valvular disease of the heart, myocarditis, goitre, albuminuria and glycosuria. With a simple bronchitis it is advisable to delay operation, and the same applies to any catarrh of the respiratory tract. Ordinary valvular disease of the heart is seldom of serious consequence provided the cardiac muscle is satisfactory; but myocarditis is a serious complication, especially if the prospective operation is likely to be prolonged or difficult. As regards enlargement of the thyroid gland, one finds that this is very common if a routine examination of all patients is made. It is not of serious consequence provided there is no tachycardia, but if this exists, the surgeon would be well advised to delay operation until the thyroid and cardiac conditions are improved by medical treatment. Albuminuria and glycosuria are serious complications, and unless the operation is one of urgency it should be delayed until these conditions are improved.

PREPARATION OF THE FIELD OF OPERATION.—The preparation of the field of operation, so that the skin, vaginal mucous membrane and the parts about the vulva are rendered surgically clean, is a matter of primary importance. It is comparatively easy to sterilise the skin of the abdomen and for surgeons to ensure that they do not convey

infection by their hands, clothing, breath, etc., but it is very difficult to thoroughly cleanse such areas as the vulva, lower regions of the reproductive tract and the cervix.

The Skin of the Abdomen and surrounding Parts.—The preparation of the surgical field in abdominal operations can be carried out nowadays very thoroughly and very effectively, especially where the patient enters the hospital forty-eight hours before operation. The first step, no matter which method of sterilising the skin is favoured, is to shave the skin over the whole abdomen, pubes and vulva. We have tried many methods, and some of us have kept careful notes of the healing of wounds under different methods, and we are convinced that there is very little to choose between the antiseptics employed. The most important step is the thorough cleansing of the parts with soap and water, but it is advisable to employ, in addition, some antiseptic. One of the oldest to be employed, and very effective, although modern surgeons do not employ it very frequently, is carbolic acid (1 : 20).

In later times, tincture of iodine came into favour. Here it is necessary that the skin, after being cleansed, should be thoroughly dried with methylated spirit. Twelve hours before operation the skin should be painted with tincture of iodine (3 per cent.) and a dry dressing applied. When the patient reaches the operating-table a fresh coat of iodine is applied. Dettol or picric acid (3 per cent. in rectified spirit) are both useful and less irritating to the skin.

Disinfection of Vulva.—The cleansing of the vulva, perineum and the area around the anus for vaginal and perineal operations is most difficult. Disinfection of this area has been fully described in connection with obstetric practice (p. 693).

If the bowels have been carefully evacuated in the manner already described, there is seldom any contamination from faeces expelled during perineal and vaginal operations, but the anal orifice should be covered by a piece of gauze fixed with clips.

Disinfection of the Vagina.—The vaginal canal is generally cleansed by douching—*this is not sufficient*. In all perineal and vaginal operations the vagina should be thoroughly washed with bicarbonate of soda solution to remove the mucus, then with ethereal soap and well dried. The final application is very much a matter of choice—Dettol or mercurochrome is excellent. This disinfection should be carried out by an assistant when the patient is on the operating-table. Where infection of the vagina is more pronounced, as, for example, in carcinoma of the cervix, more radical measures for cleansing the vagina are necessary. Some employ tincture of iodine, but a better antiseptic is a solution recommended by Browning. It consists of Brilliant Green (free from zinc sulphate), 5 per cent. ; methyl violet, 0·5 per cent., in 50 per cent. alcohol.

The vagina should be disinfected very thoroughly prior to all abdominal operations. Unless this simple rule is followed, the surgeon, in dealing with abdominal conditions, may open up possible channels of infection from the vagina. Besides, with inflammatory conditions of adnexa, adherent tumours, etc., it is often necessary to perform hysterectomy or to employ vaginal drainage—both these procedures may be followed by an ascending infection from the vagina if the latter has not been thoroughly cleansed beforehand.

Disinfection of Cervix.—In the simple operations of dilatation and curettage, the uterine cavity may be infected from the cervix, and consequently it should be thoroughly disinfected. It is difficult to disinfect, because infecting bacteria find lodgment in the glands of the canal. For the purpose, a pledget of gauze soaked in Dettol solution should be placed in the canal for two or three minutes.

Disinfection of an ulcerated cervix, the seat of carcinoma, is best secured by scraping and very thorough cleansing with "brilliant green," already mentioned. It is of supreme importance that this should be done, as a considerable number of the fatalities following the radical operation result from a low form of sepsis. However, the radical operation for cervical carcinoma with ulceration is now seldom employed if radium is available (p. 970).

SUTURES AND LIGATURES.—Except for the supporting sutures of silkworm gut, catgut is the best material for suturing tissues or ligating vessels. All varieties of suture material are now put up in sealed tubes ready for use—few surgeons prepare their own ligatures or sutures.

INSTRUMENTS.—The sterilisation of instruments is comparatively simple. In this country we generally do it by boiling, and it is certainly an easy and convenient method. In many clinics on the Continent and in America dry heat is employed. This is better for the instruments, but it is more complicated, and requires a special steriliser and fittings.

SWABS AND DRESSINGS.—The preparation of these materials is much simpler to-day than formerly. In most clinics three sizes of swabs are used: (1) large rolls of gauze; (2) large squares; (3) small squares. These are made up in packets of twelve, so that the nurse in charge of the dressings and the one who collects the soiled and discarded swabs can immediately tell at any time during the operation whether or not all swabs can be accounted for. In abdominal operations it is advisable to have long tapes (with a disc attached) sewn into one corner of the large swabs. *The smaller swabs should only be used on a holder.* By this means there is practically no possibility of a swab being left in the abdomen or vagina. The dressings employed are of the simplest—a simple dressing of the abdominal wound is a piece of gauze fixed over the wound as shown in the illustration (p. 1066). If, however, the wound has been infected, or if there is

a chance of its having been infected, sublimated or cyanide gauze may be used.

OPERATING-ROOM.—A bedroom is a poor substitute for an operating-theatre. When it is absolutely essential that a major operation should be performed in such unfavourable surroundings, the room should be, as far as possible, cleared of all hangings, furniture, carpet, etc. The danger of infection from atmospheric contamination is not great, and so operations performed in private houses give results very little worse than those performed in operating-theatres, provided attention is paid to essential details.

CHOICE OF ANÆSTHETIC.—We have already considered the choice of anæsthetics and analgesics in obstetric practice (pp. 413-422). Here we can spare only a few lines for anæsthetics in gynæcological surgery, the administration of which is to-day almost exclusively in the hands of anæsthetic specialists. The most striking developments in recent years are: (a) the increasing use made of analgesics and sedatives prior to operation; (b) the elimination almost entirely of chloroform as a general anæsthetic and the employment of "gas and oxygen"; (c) the employment of spinal and caudal anæsthesia; (d) the increasing employment of local (block) anæsthesia. Possibly spinal anæsthesia may be displaced in the future to an even greater extent by local anæsthesia and peridural block.

OPERATING-TABLE AND POSITION OF PATIENT.—It is of great advantage to the gynæcological surgeon that the operating-table should be so constructed that the position of the patient can be altered according to his wishes. For pelvic surgery the ordinary horizontal position is not so convenient as the Trendelenburg one (Fig. 418), in which the head of the patient is lowered to the extent desired, whilst the pelvis is maintained at a high level. The advantages of this position are that the intestines can be dislodged from the pelvis and packed off with gauze, that the illumination of the pelvic cavity is better and that manipulations in the deeper parts of the pelvis are more easily carried out. From the point of view of anæsthesia it has this advantage, that the risks of cardiac syncope and inhalation of mucus are lessened. It has, however, certain disadvantages, and should not be employed indiscriminately—for example, it should not be chosen if there is a pelvic abscess or infected hæmatocele, as pus or infected blood-clot may gravitate to the abdomen in spite of careful packing-off of the intestines. Occasionally, also, respiration and circulation are disturbed if there is a tendency to cyanosis, although this can be overcome by the administration of oxygen.

For vaginal operations a slightly exaggerated lithotomy position is employed. It is not advisable to push the legs too far back, and so we have always found it preferable in hospital, where there are sufficient assistants, to have the legs supported by two assistants—each assistant supports a leg with the upper part of his left arm, both hands being left

free to assist the operator. Where sufficient assistants are not available, Clover's crutch or fixed uprights at the end of the table should be employed (p. 692).

PREPARATION OF SURGEON, ASSISTANTS AND NURSES—GOWN, CAP AND MASK.—The ideal procedure is for the surgeon and his assistants to discard their ordinary clothing and put on sterilised duck suits, mackintosh aprons, and gowns. As a substitute for these they may wear sterilised linen leggings over their ordinary trousers and boots. There is no comparison, however, between the advantages of the two procedures, and the former is easily carried out in hospital practice.

HANDS AND GLOVES.—The sterilisation of the hands and forearms and the wearing of gloves have been considered in the obstetric section (p. 402). In a prolonged operation gloves should be changed once at least, and always after any accidental contamination.

2. DETAILS REGARDING TECHNIQUE

“*Team-work.*”—It is of great advantage that the surgeon and his assistants should work together harmoniously, as it expedites the operation and makes for perfection

in technique. This applies especially to abdominal surgery, now carried out almost entirely in hospitals and nursing homes.

Instruments.—There is enumerated here the ordinary armamentarium of the gynæcological surgeon. It is unnecessary to describe these instruments in detail. The following is a list of the necessary instruments for an abdominal operation: two scalpels; two long dissecting forceps; three pairs of scissors—one curved on the flat; two needle-holders; one and a half dozen small, one dozen medium, and half a dozen large pressure forceps; four open curved forceps;

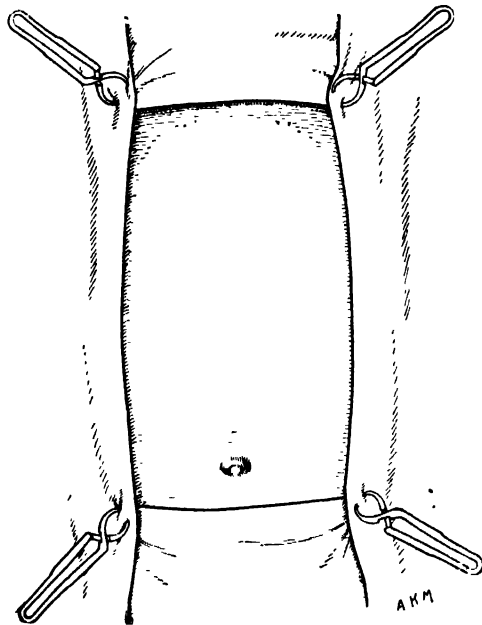


FIG. 418.—Field of Operation surrounded by towels held in position by clips; patient in Trendelenburg Position.

four volsella; two vaginal clamps (for radical operation of carcinoma of the cervix); two pairs of retractors; and one self-retaining retractor, a number of full curved, round, and bayonet-pointed needles, ligature and suture materials.

ISOLATION OF THE FIELD OF OPERATION.—There is shown in the illustration on page 1060 the arrangement of towels for isolating the field of operation (Fig. 418). This is the first step taken after the field has been prepared in the manner already described.

INCISIONS FOR ABDOMINAL SECTION.—The accompanying illustration (Fig. 419) shows the different incisions employed in the surgery of the lower abdomen and pelvis. The three commonest are the median-longitudinal through the linea alba, the paramedian, and the transverse or Pfannenstiel, incisions.

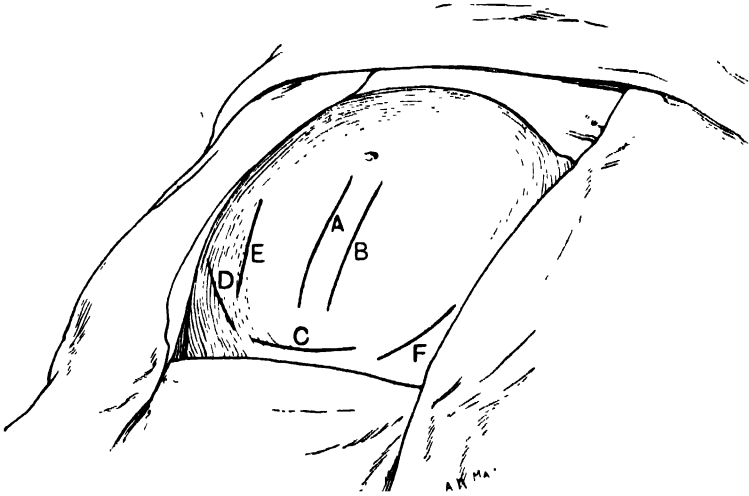


FIG. 419.—Incisions for Operations on Lower Abdomen and Pelvis.

A. Median longitudinal. B. Paramedian. C. Transverse (Pfannenstiel).
D and F. Lateral Oblique (gridiron). E. Semilunar.

Median-longitudinal Incision.—This is the most useful incision where an extensive operation is necessary and a complete investigation of the pelvic and lower abdominal structures is desired. Having cut through the skin, subcutaneous tissue, anterior rectal sheath, separated the recti muscles, and secured all bleeding-points by means of pressure forceps, the subperitoneal fat and peritoneum are divided. Here great care is necessary to avoid doing injury to the underlying bowel. This is specially apt to occur if there are any adhesions of bowel to peritoneum or if the peritoneum is very thin, for then the bowel may be easily picked up with dissecting forceps. Another structure which may be occasionally injured is the bladder, especially if it has not been completely evacuated beforehand. This particular accident is referred to later (p. 1068).

The abdominal cavity having been opened, all pressure forceps which have been applied to bleeding vessels should be removed, and if there is still bleeding from any point, the vessel should be ligated with fine catgut.

The extent of the incision depends upon what has to be done. In more complicated and difficult operations it is better to make a fairly long incision, for if the fingers and hands have to be inserted and withdrawn frequently through a small wound, the abdominal reflexes are stimulated and a deeper anæsthesia is necessary. It is a mistake to try to perform a difficult operation through too small an opening.

Paramedian Incision.—This incision is made a little to the side of the middle line. After dividing the rectus sheath, the muscle is split

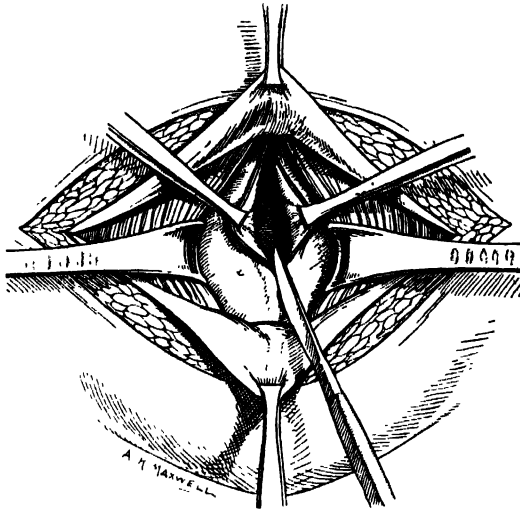


FIG. 420.—Second Stage in Transverse (Pfannenstiel) Incision.

Skin and sheath have been incised transversely. Recti muscles are retracted. Peritoneum is shown divided longitudinally.

or dragged outwards and the peritoneal cavity opened near the middle line. This incision gives an excellent cicatrix, especially if the rectus muscle is dragged over, but it does not give the operator so much room as the median-longitudinal one, and there is danger, if the wound is over-stretched, of the rectus muscle being torn.

Pararectal Incision.—This incision is made as above along the outer edge of the rectus, which is pulled over to the middle line.

Semilunar Incision.—This incision is made along the semilunar line. It is especially useful when both the appendix and the gall-bladder or duodenum have to be examined.

Transverse or Pfannenstiel Incision.—This incision is made across the abdomen about an inch above the symphysis pubis. As shown in the above illustration (Fig. 420), the skin and subcutaneous tissue and sheath are divided transversely; but the recti muscles and peritoneum are divided longitudinally.¹ The skin and sheath may be held back by pressure forceps passed through the ring or the handle of another pair which are fastened to the towel. The incision has this advantage, that the cicatrix which forms is very firm, for the sutures coapting peritoneum and muscle are at right angles to those coapting the sheath and skin. But it has this disadvantage, that it does not give a great deal of room, so that it is better to reserve it for operations on uterus and adnexa unlikely to be complicated.

¹ If these structures are also incised transversely the incision is known as "Bardelaben's incision."

Lateral Oblique Incision.—This is often referred to as the “gridiron” incision, and is specially employed for appendectomy on the right and colotomy on the left side. The incision is made parallel to Poupart’s ligament. It commences about 2 inches above the anterior superior spine, and is generally from 2 to 3 inches in length. The aponeurosis of the external oblique is divided in the line of its fibres. The fibres of the internal oblique and transversalis are separated, and the transversalis fascia and peritoneum are picked up and divided.

PROTECTION OF WOUND AND WALLING OFF THE GENERAL ABDOMINAL CAVITY WITH GAUZE.—A simple arrangement for protection of the wound is shown in the illustration (Fig. 421). Gauze is placed over the wound and a self-retaining retractor holds it in position. For the lower end of the wound the self-retaining retractor of Doyen may be employed. The intestines are walled off with long rolls of gauze. Many surgeons soak the gauze in normal saline solution before placing it in position.

If Doyen’s retractor is allowed to remain too long in the lower angle of the wound, the vitality of the tissues may be interfered with. Intermittent retraction by hand traction is less injurious than continuous retraction.

VIEWING THE CONDITION TO BE DEALT WITH.—In most instances, when the abdomen is opened, the operative procedure is obvious. But where the condition is complicated by matting of the lower abdominal structures, the surgeon should consider the position so that he may select quietly the best line of attack. Particularly does this apply to infective lesions of tube, ovary, or pelvic cavity, and to tumours adherent to surrounding structures or burrowing into the cellular tissue of the pelvis.

SECURING THE PEDICLE AND OTHER ATTACHMENTS.—There are here shown several devices for dealing with the pedicle or attachments of a removed tumour or inflamed mass (Fig. 422). *Understitching is*

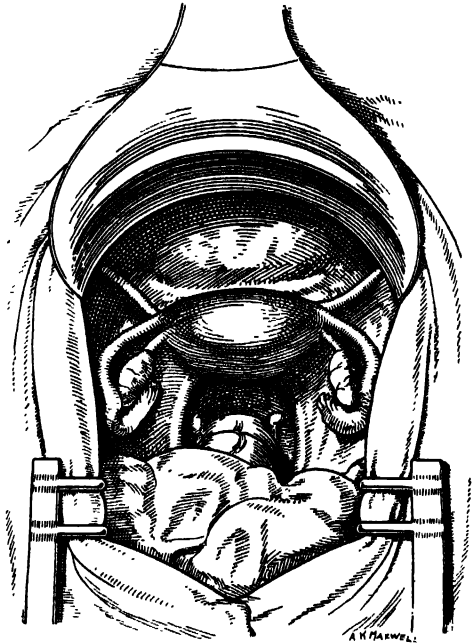


FIG. 421.—Patient in Trendelenburg Position. Abdominal wound protected by gauze; lateral self-retaining retractor in position. Doyen's retractor at lower angle of wound; intestines packed off with gauze. Pelvic organs shown in normal condition and position.

preferable to simple ligation, because with understitching there is no possibility of the ligatures slipping. For this purpose fine silk, linen thread, or catgut may be employed, but catgut is preferable.

HÆMOSTASIS.—Under this heading we do not, of course, refer to the ordinary securing of bleeding vessels, which is necessary in all surgical operations, but to the complete arrest of slight bleeding from an oozing surface. There is little danger that hæmorrhage of this nature will cause profound collapse; the danger is that these collections of blood may become infected and set up a low form of peritonitis

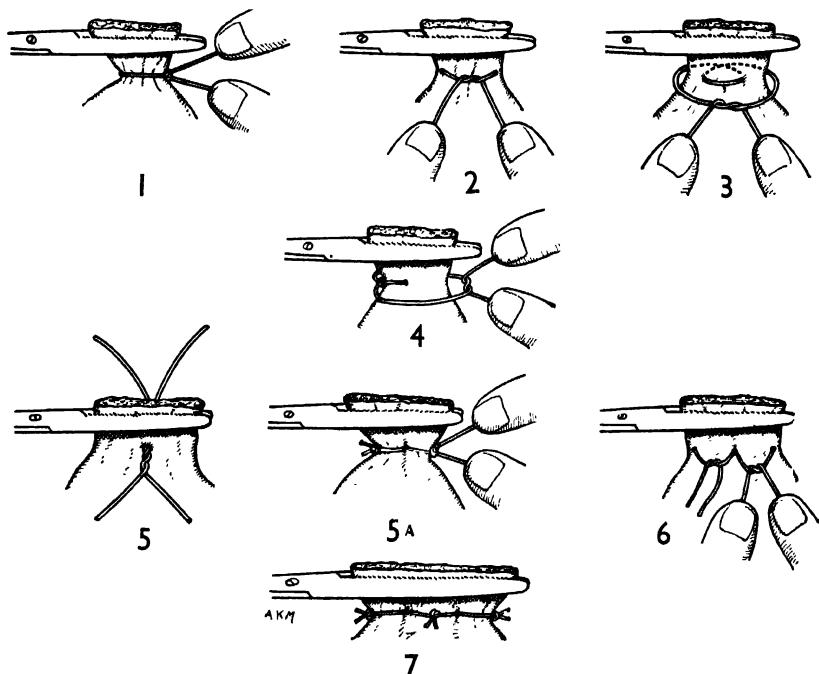


FIG. 422.—Methods of Ligating Pedicle or any Stump of Tissue.

1. Simple ligation. 2. Simple understitching and ligation. 5, 5A, 6 and 7. Dealing with a broader pedicle—sectional ligation and suturing.

where the bleeding is into the peritoneal cavity, or a hæmatoma and cellulitis if the bleeding occurs into the paracervical tissue or lower part of the broad ligament. This complication is specially liable to occur in cases of hysterectomy performed for adherent or impacted fibromyomata, or pus sacs impacted and adherent in the lower pelvis. In most of these cases it is better to remove the cervix, for should any oozing occur, there is then a free outlet through the vagina for any collections of blood, serum, etc. On occasion it may be advisable to pack the lower pelvis (see p. 1070) to ensure complete hæmostasis.

COVERING RAW SURFACES.—Next in importance comes the covering of raw surfaces, not only because it looks better and indicates

that the surgeon appreciates the refinements of his craft, but also because to these raw surfaces loops of bowel, omentum, etc., may

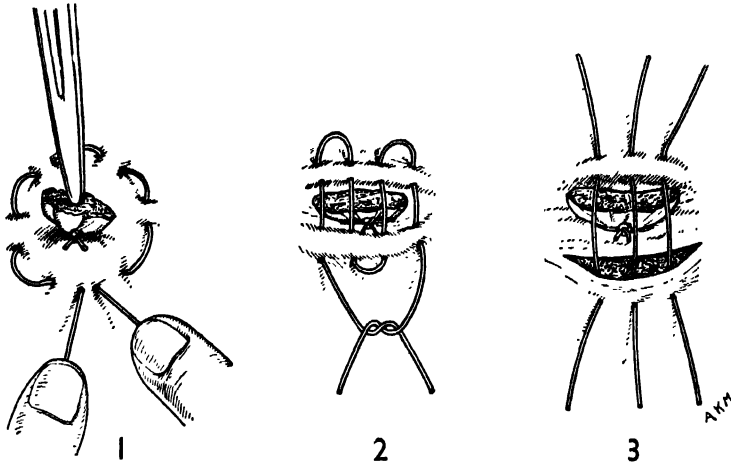


FIG. 423.—Methods for covering Raw Stump of Tissue.

adhere and cause subsequent abdominal discomfort—even more serious consequences may follow, such as partial or complete intestinal obstruction from constricting bands or adhesions.

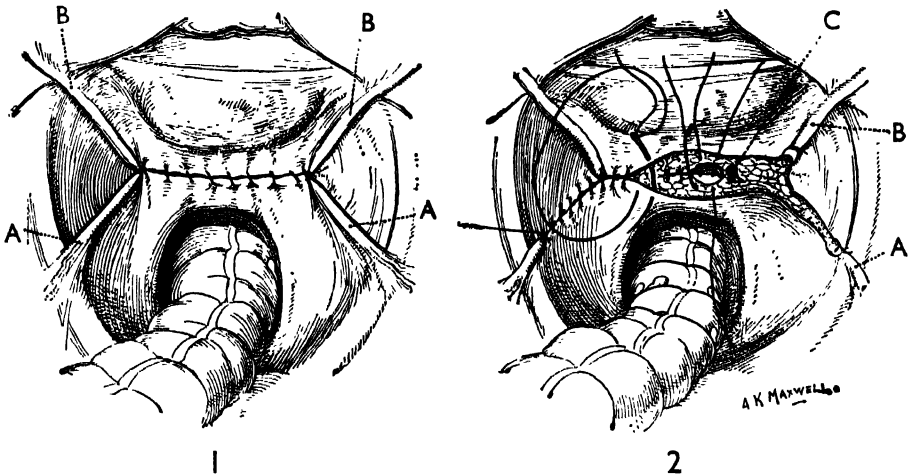


FIG. 424.—Alternative Methods for covering Pelvic Floor after Hysterectomy.

1. Utero-pelvic (A) and round ligaments (B) are brought down into lower wound. 2. These ligaments are not brought down, but anterior and posterior flaps of peritoneum are united by a continuous suture. Method 2 is preferable, as there is less "drag" on the tissues. C in figure 2 is the ligated uterine artery.

REPLACING GUT AND OMENTUM.—Before the abdomen is closed, all swabs must be carefully counted. The surgeon should then bring down the loops of bowel, and carry down into the pelvis the displaced pelvic colon if its mesentery is sufficiently lax; finally, he should cover them with omentum if possible.

EXAMINATION OF APPENDIX AND GALL-BLADDER.—It is a good rule to make a routine examination of the appendix. There is much to be said for a similar examination of the gall-bladder in all women over forty years of age.

CLOSURE OF THE ABDOMINAL WOUND.—The general method employed for closing the “*clean*” abdominal wound is indicated in the

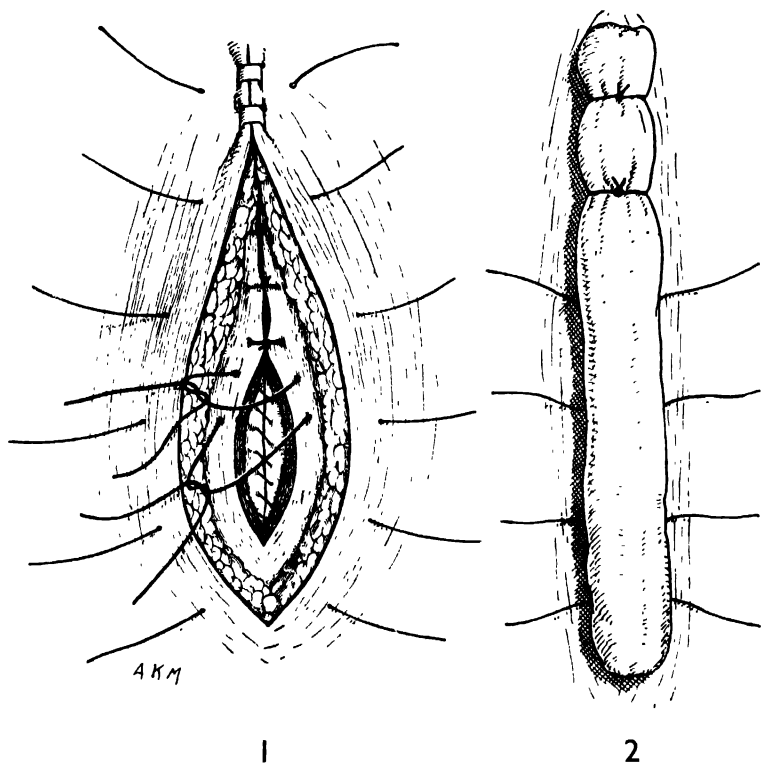


FIG. 425.—Closure of Abdominal Wound.

Method employed by author: Continuous (catgut) suture for peritoneum; interrupted (catgut) for sheath; interrupted (silkworm) through whole thickness of wall except the peritoneum; Michel's clip for skin. Two silkworm stitches are shown tied over thin strip of gauze. Gauze is not generally placed as shown if clips are used; with that procedure a layer of gauze is placed over wound and fixed with collodion.

accompanying illustration (Fig. 425). The wound is stitched in layers—a continuous catgut suture for the peritoneum, supporting silkworm through-and-through sutures taking in the rest of the tissue of the abdominal wall, coaptation of muscle and sheath by means of catgut (continuous or interrupted) according to the preference or the operator, and finally exact coaptation of the skin edges by continuous skin suture, subcuticular suture, or clips. A dressing is then applied over the wound, and the supporting silkworm sutures are tied over this dressing as shown in the illustration. An alternative dressing is a layer of gauze fixed in place with collodion. Where *there has been the*

probability of infection, it is not advisable to close wound as indicated. When the wound has been infected badly it must be thoroughly swabbed with antiseptic lotion and only silkworm gut employed—*catgut buried in a septic wound is dangerous.*

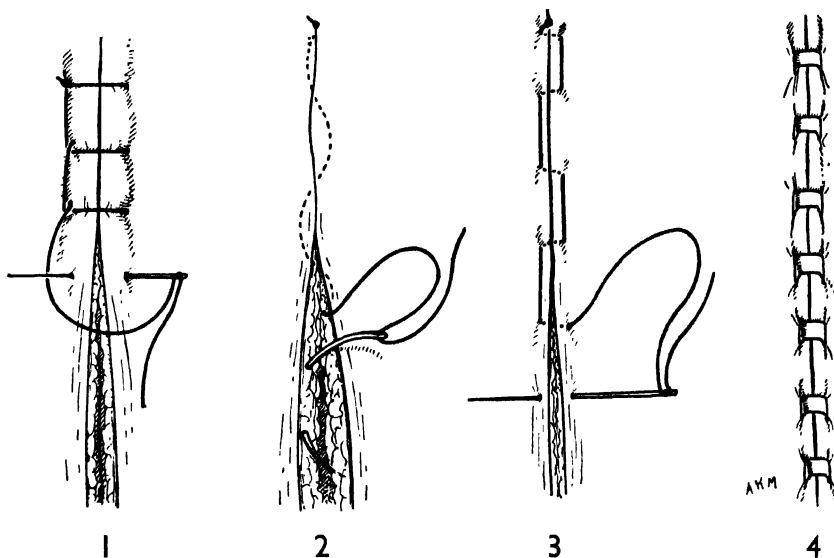


FIG. 426.—Various Methods of Coapting Skin Edges.

1. Blanket Stitch. 2. Subcuticular. 3. The glover's stitch. 4. Michel's Clips.

SPECIAL DIFFICULTIES, COMPLICATIONS AND ACCIDENTS

ADHESIONS AND INJURIES TO BOWEL.—Adhesions between tumour, inflamed tubes, appendix, and intestines is one of the commonest complications the abdominal surgeon is called upon to deal with. Where the adhesions are slight, the separation of them presents no great difficulty, but where they are intimate, great care must be exercised, otherwise the bowel may be seriously injured.

It is impossible to detail in writing how adhesions should be separated. Generally, by careful sponging with gauze and snipping with scissors the lighter adhesions can be broken down. With regard to more intimate adhesions, it will generally be found of advantage to attack any particular one from all sides on the same principle that it is easier to remove an adherent postage stamp intact by separating each corner. In some instances, and provided the condition is not malignant, a small portion of the growth to be removed may be left attached and dealt with later. *On occasion it is better to resect a portion of gut rather than spend a long time in separating adhesions*, for in such cases it often happens that in the end, having injured the bowel, the surgeon is compelled to have recourse to repair or resection of it.

In all cases where considerable difficulty has been experienced in separating adhesions, the bowel should be carefully inspected before the abdomen is closed, for infection may readily spread to the peritoneum, even although the lumen of the gut has not been opened into.

SPECIAL DIFFICULTIES WITH INFECTIVE LESIONS.—Probably the most difficult cases which the gynæcologist encounters are infective conditions of the pelvis.

We have already indicated how infection is to be prevented, how the wound is to be protected and how the loops of bowel are to be packed off. But there is one point to which we would direct special attention, and that is the danger of opening into a collection of pus from above, for, if the pus is not sterile, it will almost certainly result in infection of the wound, and possibly even of the general abdominal cavity. Where the pus is of recent formation, and is probably particularly virulent, it may be advisable to close the abdomen and deal with such collections by incision and drainage through the vagina as a temporary measure. It is unfortunate when such a procedure has to be employed, but it is certainly advisable in some instances. We do not refer here to chronic collections of pus, such as old pyosalpinx or ovarian abscess, although even with such conditions it is sometimes of advantage to deal with them temporarily as above indicated. In all cases where such temporary drainage has been employed, the condition is dealt with later when it has become quiescent. Vaginal drainage is discussed later.

URETER.—The ureter is the great bugbear of the operating gynæcologist. In all instances injury to it results from errors in technique, in most cases inexcusable, but in a few cases very nearly pardonable. The operation in which, theoretically, the ureter is most likely to be injured is the Wertheim operation, for in its performance the ureter has to be dissected out carefully; but as a matter of fact, as the danger of injuring it is constantly in the mind of the surgeon during this operation, it is comparatively seldom damaged by the operator of experience. In actual practice the ureter is more liable to be injured in removing tumours burrowing in or intimately adherent to the cellular tissue of the lateral walls of the pelvis. The distortion to the ureter which these tumours produce is often very great. The ureter may sometimes be seen coursing over the surface of the tumour and adherent to it. At other times, where the ureter is placed more posteriorly, the relationship is not so obvious, and it is therefore specially liable to be injured.

BLADDER.—Before referring to the injuries to the bladder during intra-abdominal manipulations, reference must be made to the occasional injury done to it while opening into the abdominal cavity. The accident is most liable to occur where large fibroid tumours or broad ligament cysts drag up the bladder; but occasionally it has

happened where the nurse has neglected to empty the bladder prior to operation. If there is a difficulty in entering the peritoneal cavity, the operator should not try to do so at the lower part of the wound, but, extending his wound upwards, should open into the cavity from above. In the process of making this mistake of opening into the bladder the operator's attention should be arrested by a very free oozing of blood, not the ordinary hæmorrhage from a cut vessel but a free oozing.

In accidents of this nature the injury to the bladder is very easily repaired by two layers of suture.

The injuries that result to the bladder in the later stages of an operation are specially liable to happen in the Wertheim operation performed for advanced carcinoma of the cervix. In these cases injury to the bladder is often almost unavoidable even although the greatest care is exercised. The repair of such injuries is often difficult and sometimes unsatisfactory, and a fistula may result.

HÆMORRHAGE.—Reference has been made to the importance of complete hæmostasis by the securing of all bleeding-points. It sometimes happens, however, that the oozing of the raw surface persists even although every apparent bleeding-point is secured. Rather than prolong the operation unduly, the surgeon should control the bleeding by packing the pelvis with gauze and bringing the end of the gauze through the posterior vaginal vault. When possible the peritoneum should be stitched over it so as to prevent adhesions of bowel subsequently (Fig. 427). The gauze should be left in for three or four days.

It is perfectly true that very hot saline solution or adrenalin solution will check this slight oozing, and sometimes apparently control it completely; but it is safer not to trust to this, but to pack the pelvis *tightly* with gauze as described.

DRAINAGE.—This brings us to the last and most debated subject—viz., the question of drainage. Pelvic drainage is rarely necessary except in acute inflammatory conditions, such as pelvic abscess from appendix, acute exacerbation of a chronic salpingitis, ovarian abscess, grossly infected tumours, diverticulitis, etc. The drainage in these cases can be best carried out by making a free incision into Douglas's pouch through the posterior vaginal vault. This opening can be made either from below or from above, provided the vagina has been thoroughly disinfected before operation (p. 1058). But if the vagina has not been carefully disinfected prior to operation, this must be done before the incision is made and the drainage tube inserted. The guide to this opening is the posterior wall of the cervix. The best drain is a large rubber tube split open, with a layer of gauze inside it. The gauze is placed along the lumen of the tube, and an end with tube is brought out through the vagina. For pure drainage purposes it is not advisable to use much gauze. It is quite another matter where gauze is used as a hæmostatic agent, for then

a considerable quantity of gauze may have to be used, and it must be firmly packed into the pelvis.

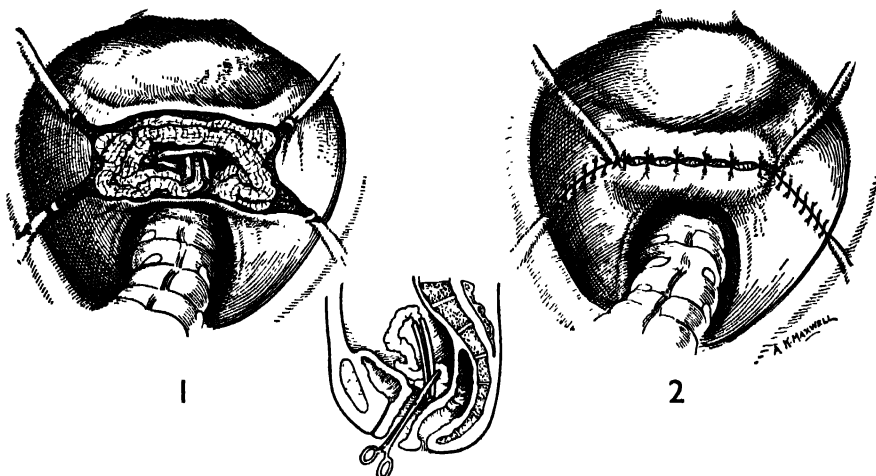


FIG. 427.—Vaginal Drainage.

1. Loose gauze packing covering raw surface, with rubber drainage tube in position. 2. Anterior and posterior peritoneal flaps brought over packing.

Inset shows the manner in which drainage tube is placed in position.

With the patient in the Fowler position, perfect drainage of the pelvis can be ensured through the vaginal vault—*this most useful route for drainage renders operations for septic pelvic conditions infinitely safer in women than in men.*

VAGINAL CÆLIOTOMY

The vaginal route of attack for pelvic lesions has never been very enthusiastically supported by British gynæcological surgeons. Their lukewarmness to it has been justified, because to-day practically every abdominal surgeon considers it necessary not only to remove or repair the diseased organ, be it ovary, tube, or uterus, but to inspect at least the appendix even if he does not remove it as a routine practice. Now, this is impossible if the vaginal incision is employed.

Still, no matter although we are prejudiced, and rightly so, against a too extended employment of the vaginal route, there are certain conditions which can be dealt with very satisfactorily through the vagina; one especially—viz., the enlarged bleeding uterus, the result of subinvolution, chronic metritis, or other causes in a patient over forty years. When it is deemed necessary to remove the uterus in such circumstances—rather than to employ the simpler treatment by radium or X-rays (p. 925)—vaginal hysterectomy is a most suitable procedure.

Vaginal hysterectomy (Mayo operation) is favoured by many gynæcologists for gross procidentia (p. 1104).

Occasionally, a small cyst of ovary or a pedunculated fibroid tumour

of the uterus may be removed through the vagina, but, generally speaking, the abdominal route is to be preferred.

The patient should be placed in the lithotomy position, the legs being held in position by two assistants so that their hands are free to assist the operator (p. 1059). Vulva and vagina receive a final disinfection, and the field of operation is surrounded with towels as shown in the accompanying illustration (Fig. 428). Special care must be taken to shut off the anal orifice in case fæcal matter may contaminate the wound.

The surgeon may open into the abdomen either through the posterior or anterior fornix. The approach through the posterior fornix is the simpler, because the pouch of Douglas is in close apposition to the posterior vaginal vault; an incision through the vault close to the cervix gives him immediate entrance into the peritoneal cavity.

The anterior route is more complicated, for the bladder must first be separated from the cervix (*vide* Vaginal Hysterectomy, p. 1119) before an entrance into the utero-vesical pouch of peritoneum can be made.

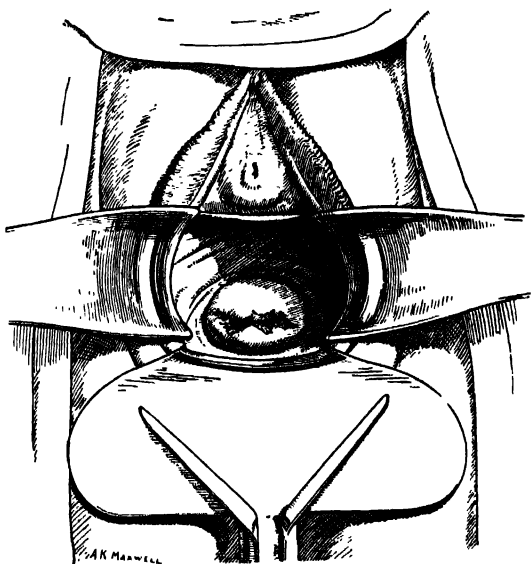


FIG. 428.—Field protected for Vaginal Operation.
Towels in position, two lateral retractors, one large posterior retractor (self-retaining, if preferred).

POSTERIOR VAGINAL CÆLIOTOMY.—An assistant, by means of an anterior and posterior vaginal retractor, holds back the vaginal walls. The surgeon then grasps the cervix with strong volsellæ, hands them over to one assistant, who pulls the cervix downwards and slightly forwards; this brings the posterior vaginal vault within easy access (Fig. 429 (1)). He then makes a transverse incision across the vault, dividing first the vaginal wall, then the cellular tissue, and finally the peritoneum. He must be careful in doing this, for coils of small intestine usually occupy the pouch of Douglas.

ANTERIOR VAGINAL CÆLIOTOMY.—Here the assistant, after he has been handed the volsellæ, firmly grasping the cervix, pulls the cervix downwards. The surgeon notes the line indicating the reflexion of bladder. If he cannot make certain of it, he passes a sound into the bladder, by means of which he can determine its lower limit. Having done this, he makes a transverse incision across the

cervix through the vaginal mucous membrane. He then passes a pair of scissors up between the bladder and anterior vaginal wall, and separates the blades, detaching by this means the vaginal wall from the bladder (see Fig. 453, p. 1101). He now proceeds to push up the bladder off its attachment to the cervix. Having done so, there is only the peritoneum of the utero-vesical pouch to divide, and he has gained an entrance into the peritoneal cavity (Fig. 429 (2)).

In the operation of vaginal hysterectomy both these openings are made prior to ligating and dividing the broad ligaments (p. 1121). When hysterectomy is not contemplated, but only the removal of a

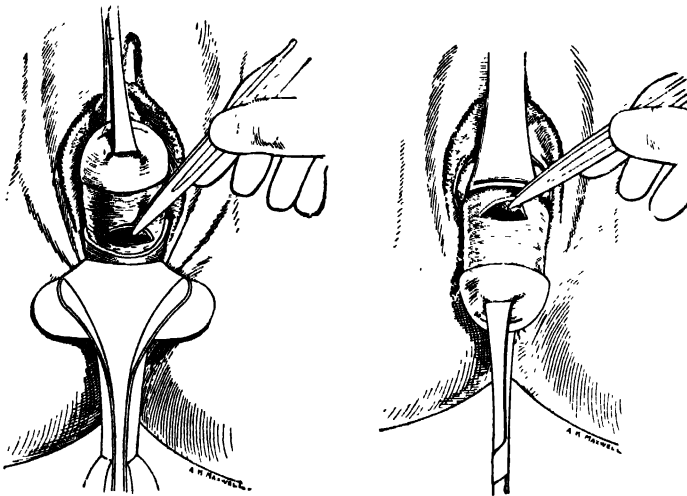


FIG. 429. —Vaginal Celiotomy.

1. POSTERIOR VAGINAL CELIOTOMY. An incision has been made round the cervix, which is shown pulled forward. The surgeon has opened into Douglas pouch.
2. ANTERIOR VAGINAL CELIOTOMY. The bladder has been stripped off cervix and is shown held back by retractor. The surgeon has opened into the utero-vesical pouch of peritoneum.

small tumour of ovary or uterus, our readers may be surprised that the posterior route is not always selected. There is, however, much to be said in favour of the anterior route, for if after entering the utero-vesical pouch the fundus is pulled out through the opening by means of a volsella a cystic ovary or small fibromyoma can be removed very conveniently, or in the case of a cyst of the ovary the latter can be resected. However, it is very much a matter of opinion; but most operators prefer the posterior to the anterior line of approach.

After the intra-abdominal part of the operation is completed, the anterior or posterior vault is closed with catgut. If the anterior route has been employed, the bladder previously pushed up is brought down and fixed in position. Finally, some loose gauze packing is inserted in the vagina around the cervix.

MINOR VAGINAL AND PERINEAL OPERATIONS

There is nothing special to be said regarding technique in such operations. The difficulties regarding cleansing the field of operation and contamination of the wound have been already referred to.

3. POSTOPERATIVE TREATMENT

In the majority of cases *the patient's fate is sealed in the operating-theatre, but in a few instances, more especially where the operation has been of great severity, prolonged, and followed by shock, and where her life hangs in the balance, careful nursing may make all the difference between recovery and death.* Good nursing, however, in every case, adds immensely to the patient's comfort, and hastens her recovery and convalescence.

IMMEDIATE TREATMENT.—The patient, on leaving the theatre, should be placed in a comfortable bed warmed by two hot-water bottles *well protected by a flannel covering.* It is of great importance that the skin should be kept warm, and so, for the first hour or two at least, it is often advisable to wrap the patient in blankets, with hot bottles at her side.

It is generally advisable to have the patient lying on her back with her head turned towards one side. Should there be much collapse, the lower end of the bed is raised on blocks, provided the condition for which the operation has been performed was not associated with grave pelvic sepsis. As soon as possible the patient's shoulders should be raised, and in cases of definite pelvic sepsis she should be placed in the Fowler position. It will be found inadvisable at this stage to push stimulants unless the patient shows signs of collapse, in which case ephedrine and coramine are probably the most effective drugs. In the slighter cases coramine (1 c.c.) with or without strychnine ($\frac{1}{80}$ to $\frac{1}{30}$ gr.) may be administered hypodermically (Shock, p. 1078).

In many instances the patient, as she comes out of anæsthesia, becomes restless, complains of pain, and has little control over her emotions. Should this be the case, it will be found advisable, unless there are distinct contraindications, to administer a small hypodermic dose of morphia ($\frac{1}{8}$ to $\frac{1}{6}$ gr. is generally sufficient).

After a severe operation a special nurse should sit by the patient's bedside for an hour or so, and note from time to time the respirations, pulse-rate and general condition of the patient.

POST-ANÆSTHETIC VOMITING.—In most instances this is the first and chief disturbance which the patient suffers from after an abdominal section. The degree of the vomiting and its persistence are dependent upon several factors. *Firstly*, it is undoubtedly most troublesome if chloroform has been employed. *Secondly*, it is very much affected by the manner in which the anæsthetic has been administered. There

is not the slightest doubt that the more perfect the anæsthesia the less will be the vomiting. *Thirdly*, it is affected by the preparation beforehand. Undoubtedly a careful preparation beforehand, with a restricted diet and securing good renal elimination, conduces to less postoperative vomiting. But temperament and idiosyncrasies also play an important part.

Very often, where the operation has been prolonged and chloroform employed, the sickness is delayed for twelve to twenty-four hours, with the result that the patient is infinitely more disturbed than if it had occurred earlier. The graver forms of "delayed chloroform poisoning" are referred to later.

In all cases where the sickness persists for more than twenty-four hours the stomach should be washed out with bicarbonate of soda. This lavage of the stomach is most helpful, and is not sufficiently often employed. In slight sickness and nausea, teaspoonful doses of bicarbonate of soda and water, or, better still, milk of magnesia, are often helpful. The ordinary drugs employed for gastric disturbances are of little value, and morphia with or without hyoscyne sometimes aggravates the sickness. In troublesome postoperative sickness one method to arrest sickness is repeated washing out of the stomach by means of the stomach tube. A Ryle's tube left in the stomach for several hours is, however, a more valuable aid in alleviating sickness. Glucose salines (5 per cent.) should be given rectally.

THIRST—SALINES.—All patients suffer less or more from thirst after operation. The degree of discomfort depends very much upon the severity of the operation, the amount of blood lost and the shock produced, and, of course, the self-control of the patient. A number of years ago continuous saline infusion into the bowel was much favoured, but we have found that small saline infusions at two to four hourly intervals are preferable. Where large draughts of fluid are given to wash out the stomach, thirst is not very troublesome—a point in favour of this as against the other procedure of cutting down fluid to a minimum. Hot water is better than cold: it is safer, and allays thirst better. Ice is rarely employed nowadays, as it aggravates the thirst and parches the tongue.

PAIN.—There is seldom severe pain after an abdominal operation, the suffering is more a feeling of discomfort and restlessness. Consequently, one generally finds that a slight sedative such as morphia ($\frac{1}{8}$ to $\frac{1}{4}$ gr.) is all that is necessary; or, if there is no actual pain, veganin by mouth or sodium luminal intramuscularly may be given. Bromides may be added to glucose salines if sickness is troublesome. After some pelvic operations, however, pain is severe, as, for example, operations on the round ligament for backward displacement, and all perineal operations. In such cases morphia in some form is the only drug which gives relief.

In abdominal operations, however, it is not advisable to repeat

morphia very often, as it tends to inhibit peristalsis and aggravate flatulence, which often causes the patient much discomfort. In some patients, too, it appears to aggravate sickness. In such cases omnopon may be substituted.

FLATULENCE.—Practically all patients suffer from a certain degree of flatulence after an abdominal operation, and in some it causes extreme discomfort, exhaustion and depression. It seldom is troublesome during the first twenty-four hours, but from then onwards until the third day it is generally more or less pronounced. On the second evening the flatus tube may give relief; if this fails, a flatus enema should be given and $\frac{1}{2}$ c.c. pituitary extract injected at the same time. This may be repeated a few hours later.

BOWELS —Flatus enemata are generally insufficient to secure a good evacuation of the bowels, and so it is advisable on the third or fourth day to administer a purgative by the mouth. No purgative is better than castor oil, which, if well disguised with a little brandy and essence of peppermint, can generally be taken without causing the patient any feeling of nausea. Other drugs, such as calomel (1 gr.) with bicarbonate of soda given at intervals of an hour until three doses have been administered, and followed by a saline; cascara sagrada, aloin and belladonna pill, Hamilton's pill, etc., may be substituted. These are seldom as satisfactory as castor oil. Should the evacuation be unsatisfactory, a large enema of soap and water and turpentine should be administered.

The regulation of the bowels later is a more troublesome matter, for with a patient lying in bed it is often difficult to hit upon a suitable laxative. A more liberal diet with the help of such laxatives as petroleum or a mild aperient pill is generally sufficient.

URINATION.¹—Difficulty in urination is another of the minor disturbances of abdominal, but more particularly of perineal, operations. Many patients find it very difficult to urinate in the dorsal position. If, however, they are supported by a nurse and the shoulders well raised, this difficulty is overcome. Applications of hot water and fomentations over the vulva may often be of assistance, but only in abdominal cases. Doryl (1 c.c.) intramuscularly is sometimes of value.

It is most desirable that catheterisation of the bladder should be avoided if possible, for even with the greatest care it is difficult to prevent infection of the bladder. Not only must the nurse's hands be cleansed and the catheter sterilised, but the parts about the urethra must receive the greatest attention. If the catheter is being passed repeatedly, it is advisable to prescribe urotropin (gr. v, *t.i.d.*) as a prophylactic. It is very important to prevent infection of the bladder, for otherwise severe cystitis and pyelitis may follow. If repeated catheterisation is necessary, a good plan is to give half a

¹ After severe operations, especially if there is any suspicion of injury having been done to bladder or ureter, the fluid intake and urinary output should be accurately charted.

tablet of sulphonamide six times daily after an initial dose of two tablets. Patients are seldom upset by this dosage over two or three days.

GENERAL CONDITION OF PATIENT.—The appearance of the patient tells one pretty well how she is progressing. The pulse, temperature and respirations, which are always carefully recorded at four-hourly intervals, indicate the progress. Very commonly, after a severe or prolonged operation, there is a fall of temperature succeeded by a sharp rise. This rise does not continue, and the temperature soon falls to the normal or slightly below. The condition of the pulse is even more important than the temperature as a guide to the general condition of the patient. It is very easily disturbed, however, after operation—for example, it is often altered by a little spasm of colic, or if flatulence is very troublesome. *A rising pulse generally indicates grave danger, and this often precedes any appreciable rise in temperature.* Any alteration in the respiration should also be noted. If there is peritonitis, the respirations become more rapid and shallow. The same applies if pulmonary complications develop. These features will be referred to more fully in connection with the various complications following operation.

DIET.—Diet for the first two days should consist of fluids, such as egg albumin, chicken tea, weak tea. Later Allenbury Diet or Benger's Food may be given. Milk is seldom well digested. It will generally be found advisable to get the patient on to a fairly liberal diet as soon as possible. It is a great mistake to give her large quantities of starchy foods, as these frequently cause flatulence and indigestion. It is seldom necessary to give alcohol, but sometimes the patient is benefited by a dessertspoonful to a tablespoonful of whisky or brandy at the midday and evening meals; wines may be given if the patient expresses a desire for them. Where the patient has been much run down before the operation, and requires extra nourishment, a more liberal diet may be prescribed. It is a mistake, however, to push the feeding-up process too far, for the digestion is liable to give out, and minor discomforts, such as headache, nausea, etc., may develop.

As indicated in the brief list above, importance is laid on the administration of a suitable quantity of fluid. This is very important, as the patient is always benefited by free renal flushing.

PASSIVE RESISTANCE EXERCISES.—Gentle passive resistance exercises for limbs may be prescribed; but they are not so necessary for the *post-operationem* as the *post-partum* patient.

THE WOUND.—Where there has been little likelihood of septic infection, the wound need not be dressed until the stitches are removed. An exception, however, must be made if Michel's clips are employed, for they should be removed on the fifth day. It is well to leave the deep supporting stitches until the tenth or twelfth day. There is no advantage in removing them earlier. Before their removal the wound may be bathed with some antiseptic, such as

methyated spirit. Sterilised gauze is afterwards placed over the wound, and adhesive strapping applied to keep it in place.

Where, however, there has been any risk of contamination, and certainly if the wound becomes infected, regular dressing of the wound has to be carried out. The treatment of infected wounds is referred to later (p. 1082).

“GETTING UP.”—Most patients may be allowed to rise any time after the fifteenth or sixteenth day, but no hard-and-fast rules can be laid down regarding this matter, nor regarding the duration of the convalescence (*vide infra*).

ABDOMINAL SUPPORT.—It is unnecessary to prescribe any abdominal support where the wound has been carefully stitched and has healed satisfactorily. Furthermore, it is very questionable if any abdominal support has the slightest effect in controlling or preventing a ventral hernia. Abdominal supports may give a certain degree of comfort to the patient, and undoubtedly are beneficial in enteroptosis and nephroptosis, but they cannot possibly have any effect in controlling intra-abdominal pressure. Preferable to a complicated abdominal belt is a pair of well-fitting, straight-fronted corsets. The patient should be carefully measured and fitted for such corsets.

CONVALESCENCE.—It often happens that the care expended by surgeon and nurse does not secure as satisfactory a result as was hoped for. There is an appreciable number of patients who are not benefited to the extent they and the surgeon expected. Sometimes this is because the condition for which the operation was performed was not the entire cause of the patient's discomforts. But in a considerable number of cases the disappointment is really the result of a too hurried or inadequate convalescence.

It is impossible to lay down any rules as to how a patient should convalesce, for that depends upon many circumstances. But one thing is quite certain, that convalescence should be slow, and that the patient should feel her way very cautiously and never overtax herself to the extent of being unduly fatigued. Change of air and surroundings, tonics, and a suitable dietary, combined with physical and mental rest, are of great service. Unfortunately, however, few patients can give up several months to convalescence. All one can do for most individuals is to help them as much as possible with tonics and advice as regards diet, rest and exercise, or work.

POSTOPERATIVE COMPLICATIONS

Some of the minor disturbances following operation, such as sickness, difficulty in urination, etc., have been referred to already. Here we discuss briefly those of a more serious nature which, fortunately, with careful preparation of the patient and perfected technique, are now relatively seldom encountered. We shall discuss them in the order of their occurrence.

SHOCK.—Surgical shock is a clinical state in which all the vital functions of the body are depressed, sometimes to a moderate degree, sometimes to a degree which rapidly leads to a fatal issue. All recent researches point to the complex nature of its ætiology, for several factors operate to establish the condition. But there is no doubt that the state of shock is one of failure of the circulation—a rapid fall of blood-pressure that initiates the signs and symptoms that inevitably follow. The factors producing shock cause overstimulation of the sympathetic nervous system, leading to constriction of the arterioles of the skin and dilatation of the vessels in the skeletal muscles of the body, and perhaps also of the vessels of the splanchnic area. This dilatation leads to vascular stasis and to the escape of blood-plasma from the vessels into the deeper tissues: consequently the volume of circulating blood is greatly diminished and the blood-pressure rapidly falls. This fall leads to depression of the vital functions of the body, to asphyxia of tissues and to changes in the blood chemistry. The aim of treatment is, therefore, to restore adequately the blood-volume and to raise the blood-pressure before irreparable damage is done to vital centres: such damage will inevitably result from the prolonged fall of pressure.

Factors operating to produce shock vary in different circumstances, as may be seen when comparing the shock of the wounded man with that of the civilian operation case. The wounded soldier may have extensive bruising of his tissues, the products of which are early absorbed, and, further, his wound may become early infected: indeed, a bacterial infection, with its resulting production of toxins, occurs much earlier than many suppose. Then cold (a very important factor), unsuitable food, delay between the time of infliction of the wound and operation, and lastly, mental strain and fear in many instances must be given due consideration.

In operative work the factors that predispose to shock are the following: (*a*) fear of operation: (*b*) anæmic state of patient; (*c*) prolonged operation; (*d*) loss of blood; (*e*) separation of adherent structures with trauma to the visceral or parietal peritoneum; (*f*) deep dissection in the pelvic cellular tissues; (*g*) undue handling of intestines; (*h*) anæsthesia; (*i*) cold. Suitable preoperative treatment, gentle handling of the abdominal contents, prevention of hæmorrhage, well-chosen anæsthesia, and the minimum of exposure of the patient on the operating table—attention to these important points will greatly reduce incidence of shock.

The symptoms are fairly characteristic and follow operation almost immediately. The surface of the body is cold and pale, though there may be slight cyanosis of the tips of the fingers and toes: the temperature is subnormal; clammy perspiration is common; the blood-pressure is very low and the pulse rapid and feeble; the pupils are dilated and the face drawn and pinched: the limbs are relaxed and

movements sluggish; the respirations shallow and may be irregular: thirst may be marked; mental apathy is often pronounced. If shock persists the patient gradually becomes more listless and finally unconscious.

Should the patient recover, these symptoms gradually disappear, the surface of the skin becomes warmer, she becomes restless, the pulse becomes fuller and the respirations less frequent.

This type of shock is often spoken of as *primary* shock, and is, as already mentioned, easy of recognition. But there occurs occasionally a later form of shock, which comes on a few hours after the operation—which may be very difficult to distinguish from the second complication to be referred to—viz., hæmorrhage.

It is one of the most difficult problems the surgeon has to deal with after operation, the differentiation of this later shock and hæmorrhage. A correct diagnosis is of great importance, because the treatment of the two conditions is entirely different. In the case of shock everything must be done to relieve it by medical means, but in the case of internal hæmorrhage medical remedies are of little avail; the abdomen must be opened and the bleeding arrested if the patient is to be rescued. We must, therefore, try to indicate how shock and hæmorrhage can be differentiated.

THE DIFFERENTIATION OF SHOCK AND HÆMORRHAGE.—Where *shock* occurs, the operation has generally been severe or prolonged, or the patient has been in an exhausted condition beforehand. It comes on soon after the operation. The patient becomes lethargic, the pulse small, rapid and thready, and the respirations rapid. With *hæmorrhage*, on the other hand, the patient may have had no severe abdominal operation, may not have been sick, and may have been in perfect health prior to operation. If, for example, the ligature controlling a large vessel gives way, she is seized suddenly with a feeling of faintness. But more often she gradually becomes *restless* and pale. She often, too, complains of abdominal pain. She complains of great thirst also and ringing in the ears. The pulse becomes progressively more rapid, weak and soft. The temperature is of little help, as in both conditions it is subnormal. Comparatively early, however, the respirations are affected. they become deep, and later sighing, as a result of air-hunger. Still later there may be recurrent attacks of syncope. *An important point in distinguishing between shock and hæmorrhage is the fact that in shock most patients respond very quickly to treatment, unless the shock is very profound, whereas in hæmorrhage this same treatment produces little, if any, improvement until the bleeding is arrested.* In shock the patient is languid, in hæmorrhage she is restless. In cases of doubt—and sometimes it is almost impossible to say which condition is present—an incision through the posterior vaginal fornix or the stitched vaginal canal (if the uterus has been removed) will show if there is any collection of blood in the pouch

of Douglas. Naturally, if there is free exit from the pelvis, or vaginal drainage has been employed, the escape of blood is apparent.

The treatment of hæmorrhage is to reopen the abdominal wound and secure the bleeding vessel or vessels.

The treatment of shock consists in warmth to the body, rest and the administration of fluids. Warmth may be given by hot bottles or, better still, an electric shock cage, and rest may be ensured by injection of morphia. Fluids are best given by the slow intravenous drip method. (Glucose (5 per cent.) in saline is helpful, *but transfusion with blood-plasma is the ideal.* Whole blood is of advantage, but is not so good as plasma, which replaces the loss into the patient's tissues. The blood is, in shock, too concentrated with red cells because the red cells remain in the vessels while plasma escapes—hence the need for the latter. But where hæmorrhage is a factor in the production of shock, then whole blood should be given by slow transfusion. The foot of the bed should be raised and the patient given drinks when she is able for them—sweetened tea is as good as anything. If fluid is not given intravenously, glucose and saline should be administered rectally.

It is doubtful how much benefit may follow the administration of cardiac stimulants. Certainly frequent stimulation is unwise, but an injection of coramine may be given and repeated in four hours, and brandy may be applied to the lips. If treatment is promptly instituted most cases will respond satisfactorily; if delayed, the prolonged low blood-pressure will lead to irreparable damage to the essential centres.

DELAYED SHOCK.—There is another form of progressive collapse which is occasionally encountered quite distinct from the shock occurring shortly after the operation; to this the term "delayed shock" has been applied. It is a complication of quite a different nature, and should not be termed "shock," as it is generally a manifestation of *grave sepsis of an insidious nature.*

PERITONITIS.—This complication is relatively rare nowadays, at least in the form of acute general peritonitis with the characteristic symptoms of abdominal pain, distension, sickness, vomiting and gradual collapse.

We still encounter, however, a more localised form of peritonitis confined more particularly to the pelvis and running an insidious course. This low form of peritonitis is specially prone to follow an operation performed for some septic condition in the pelvis, but it may occasionally occur even in so-called "clean" cases where infection has been introduced by the surgeon or has spread from an injury to the small or large bowel. Here we find that the patient may progress quite satisfactorily for the first two or three days, or even longer, but generally by the fourth, and rarely later than the sixth day, her condition gradually becomes more and more unsatisfactory. She generally complains of a certain amount of uneasiness, sickness frequently returns, the pulse becomes rapid, and the temperature

generally rises also, although in a few cases it may rise very little above normal. Associated with these symptoms there is a certain degree of abdominal distension which may become extreme, the abdominal wall becoming blown out to an enormous extent. The enemata, which at first were followed by the passage of flatus, are less effective. Later, there is complete inhibition of intestinal peristalsis. In this postoperative variety there is generally a steady progress downhill, but early recognition of the condition and energetic treatment may result in the patient being rescued.

The treatment which should be employed is free incision and drainage of the pouch of Douglas. Not infrequently it will be found that with the incision there is a free escape of a certain amount of pent-up blood and serous fluid. Having established free drainage and left a drainage tube in the pouch of Douglas, the patient should be propped up in the Fowler position and the stomach washed out if she has any sickness. Glucose salines by continuous intravenous drip should be given.

DELAYED CHLOROFORM POISONING.—This term is used somewhat loosely. Although we are quite prepared to believe that there occasionally occur genuine examples of this complication, it is for the most part a manifestation of septic absorption. We have proved this on one or two occasions where, after incising the pouch of Douglas and evacuating the contents, all untoward symptoms have rapidly disappeared.

There do occur, however, examples of what, for want of a better term, we refer to as *delayed chloroform poisoning*. Although it may occasionally occur after the simplest operation, it is most prone to arise in operations performed for septic conditions, such as appendicitis or salpingitis and when chloroform anæsthesia has been prolonged. Its occasional occurrence is one of the strongest arguments against the employment of chloroform.

Generally there is an interval of twenty-four to thirty-six hours before the sickness commences, then persistent vomiting and progressive prostration follow. In fatal cases the patient becomes comatose, this latest phase being occasionally preceded by convulsions. The changes in the urine are very definite, acetone and diacetic acid being easily recognised by the ordinary tests. The appearances of the liver at autopsy are similar to those present in other toxæmias—*e.g.* eclampsia (p. 221).

The condition is treated with small quantities of bicarbonate of soda by the mouth, and glucose (10 per cent.) and bicarbonate of soda by the bowel. Glucose should also be administered intravenously and calcium gluconate intramuscularly—10 c.c. of a 10 per cent. solution.

ACUTE DILATATION OF STOMACH.—Acute dilatation of the stomach is not often encountered after gynæcological operation. It is associated

with paresis of the walls of that viscus and the secretion of quantities of fluid, which distend it enormously. The condition may come on relatively suddenly, or may develop more gradually (Intestinal Paresis).

The abdomen becomes distended and tympanitic, the patient feels much distressed, and the pulse increases in rapidity. Sickness occurs from time to time: this is often an "overflow sickness" which gives temporary relief. The appearance of the fluid is dark brownish or "coffee ground." As the condition is a grave one, it is necessary that prompt and energetic measures should be taken. The stomach should be drained by a Ryle's tube for several hours. Later enemata should be given. Intravenous salines and glucose are advisable. The condition is usually associated with peritoneal infection.

INTESTINAL PARESIS — INTESTINAL OBSTRUCTION. — Intestinal paresis is generally a septic manifestation, and in the graver forms with a fatal termination distinct evidences of peritonitis are present on post-mortem examination. But there occasionally results a paresis of the gut which, so far as one can judge, is not due to peritonitis, but results from gastro-intestinal infection, fermentation and acidosis. It is often associated with acute dilatation of the stomach, and, generally speaking, it is preceded by considerable postoperative sickness. The condition is to be treated in the same manner as acute dilatation of the stomach.

In some instances it is not a little difficult to determine which form of tympanitis exists, for sometimes, with a low form of peritonitis, there is comparatively little pain beyond discomfort, the result of the distension.

Intestinal Obstruction.—Definite intestinal obstruction may occur as a result of constricting bands, or holes in omentum permitting loops of bowel to pass through and be strangulated, but for the most part these forms of obstruction are relatively late manifestations. More commonly the obstruction occurs as a *result of a volvulus* brought about by intestinal paresis and distension. Intestinal obstruction is invariably associated with the usual symptoms of sickness—the vomiting gradually becoming fæcal. But the characteristic symptom is paroxysmal pain in addition to the general abdominal discomfort of simple paresis and the intense constant pain of peritonitis. Immediate abdominal section is naturally the only procedure which will save a patient suffering from this grave complication.

INFECTION OF WOUND.—Infection of the abdominal wound is rarely observed, except in cases where the operation has been performed for some septic condition. Still, sometimes, in spite of the greatest care, it does occur. Most commonly the infection is from the skin. Occasionally, if a hæmatoma forms in the wound, the source of infection is an adherent loop of bowel. The infections from the skin are specially prone to occur round the site of the sutures. It will be found generally that the best procedure is to remove the infected

stitches and apply a wet antiseptic dressing. If there is any actual collection of pus, the opening should be enlarged and the cavity washed out. The wound should be dressed repeatedly, and gauze wrung out of antiseptic lotion should be applied. Various antiseptic preparations may be employed, such as flavine, eusol, peroxide of hydrogen, etc.

If the deeper stitches become infected, the healing process may be long delayed. This is specially observed where silk has been used, but chronic gut sometimes takes months to absorb or be discharged. When possible the infected stitch should be removed. It happens occasionally that in deeply infected wounds a bowel fistula forms. Should this unfortunate accident occur, and should the fistula persist in spite of careful dressing, the affected loop of bowel must be resected later. This is naturally a difficult and dangerous procedure, because of the adhesions present and the risks of infection, for it is very difficult to thoroughly cleanse the field of operation in such circumstances. The wound must be thoroughly disinfected, and it will generally be found advisable to make a fresh incision to the side of the original one, so that the affected loop of bowel can be approached from all sides.

A very serious complication of badly infected wounds is *rupture of the wound* and the protrusion of the bowel. Fortunately it is extremely rare, but if it does occur the outlook is naturally grave. The wound must be disinfected as thoroughly as possible, the bowel replaced and fresh stitches introduced.

URINARY DISTURBANCES.—We have already referred to the difficulty of urination and to the cystitis which may occasionally follow the employment of a catheter. In most cases after operation, even when a good diuresis has been established beforehand, there is a decrease in the quantity of urine passed, but usually after twenty-four hours it gradually increases until the quantity comes back to the normal. It is always a good sign after an operation if the patient passes a good quantity of urine.

Suppression of Urine.—Putting aside the very occasional cases where the suppression results from ligation of the ureters in the operation of hysterectomy (in which case there is absolute suppression from the first) postoperative suppression comes on gradually. But in a few cases it is present from the first; the condition is sometimes referred to as “renal shock.”

Recovery very rarely occurs where complete suppression of urine develops. Such measures as the introduction of saline by a vein and cellular tissue is the ordinary treatment which should be employed. Intravenous injection of 4·28 per cent. solution of sodium sulphate is sometimes successful in re-establishing urinary secretion. It should be run in slowly. At the same time, the patient should receive a saline purge and drink large quantities of bland fluid. Hot bags should be

applied to the back, and such drugs as pilocarpin ($\frac{1}{8}$ gr.) given hypodermically may be employed. Generally, as indicated, however, these remedies are only efficacious in the milder examples of suppression.

Incontinence of Urine.—This usually results from overdistension of the bladder and is an overflow incontinence. In cases where there has been any injury done to the bladder there will naturally be a continuous urinary discharge from the fistula.

THROMBOSIS.—This is by no means an uncommon complication. It occurs in about 0·5 per cent. of abdominal operations where the cellular tissue in the lateral walls has been opened into in the removal of the uterus for fibroids, carcinoma of cervix, pyosalpinx, etc. *Occasionally, it is observed in cases where the abdominal operation is of the simplest nature.* In many instances it is due to infection from the cervix (e.g., following subtotal hysterectomy).

In the less grave form the manifestations resemble those of post-partum thrombosis, commonly referred to as Phlegmasia Alba Dolens (p. 648). It generally develops about the end of the second week, is usually preceded by a slight rise of temperature, and sometimes a certain degree of pelvic pain. There is often pain along the course of the thrombosed vessels and in the calf of the leg, which becomes swollen and œdematous. The recovery in this postoperative phlebitis is generally better than in the phlebitis of the puerperium, but in a number of cases the thickening of the leg persists, and is liable to recur on over-exertion.

PULMONARY COMPLICATIONS.—Pulmonary Embolism.—The most grave pulmonary complication is pulmonary embolism. It comes on suddenly, the patient being seized with a severe precordial pain, rapid and gasping respirations. The skin becomes clammy and cyanotic, and the patient presents a very distressed appearance. Death usually occurs in a few minutes. Nothing can be done for this condition beyond relieving symptoms by giving small doses of morphia ($\frac{1}{8}$ gr.) and oxygen inhalations. Only the slighter cases recover. Recurrent small emboli are almost invariably the result of infection in the operation area, and they frequently lead to septic broncho-pneumonia and death.

Pleurisy.—Pleurisy, which occurs occasionally after operations, is generally an evidence of infection, but at times it would appear to be due to a direct chill where a patient, convalescing in bed, is exposed to a draught. A small pulmonary embolus is the commonest cause.

Pneumonia.—This may occur shortly after an operation from inhalation of septic material, but occasionally it is due to infection from the site of operation. Most commonly it takes the form of a broncho-pneumonia rather than a lobar pneumonia.

Bronchitis.—This in a mild form is not an infrequent complication. It may be due to the administration of cold ether, or exposure of the

patient while removing her from the theatre to the room or ward. It generally passes off in a few days with suitable treatment.

SUBPHRENIC ABSCESS.—This grave complication is not common, and almost never arises except when the operation is performed for some infective condition in the abdomen, more particularly connected with the region around the stomach, duodenum, pancreas, gall-bladder, or appendix.

In some cases it develops quite early, but in a considerable number it is a late complication.

It is associated with a septic temperature, and later with dyspnoea. If the collection of pus is considerable, physical signs in the lower part of the lung and upper abdomen may be quite distinct. Whenever recognised the pus should be evacuated after resection of ribs.

PAROTITIS.—This is now a relatively rare complication. It arises from infection of the parotid gland through Stenson's duct. It is less common now than formerly, as greater attention is given to the mouth before operation. Generally only one side is affected, but occasionally both glands may become involved. It is most prone to occur should the mouth become very dry and foul. This is to be avoided by giving the patient a considerable amount of fluid to rinse her mouth, and allowing her relatively early after operation to swallow a reasonable amount of fluid. When this complication arises, cotton-wool should be applied to the side of the neck. It is inadvisable to poultice or foment the part too frequently. In most instances the inflammation gradually subsides, but occasionally it goes on to abscess formation, when incision and drainage of the gland are necessary.

INSANITY.—This is generally of septic origin and of the maniacal type. But the complication may develop occasionally in individuals predisposed by heredity to insanity or previously affected by any mental disorder.

CHAPTER LIV

MINOR OPERATIONS: DILATATION OF THE CERVIX AND CURETTAGE

DILATATION OF THE CERVIX

THIS operation is most commonly undertaken as the first step in curettage, but by itself it may be indicated for the treatment of spasmodic dysmenorrhœa or for sterility. Although it is a minor operation, all antiseptic precautions must be taken and the patient prepared in the usual way, as already described.

After the patient is anæsthetised, a careful bimanual examination should be made, even if this has already been done previously, in order to determine the exact condition of affairs in the pelvis and particularly to exclude the possibility of early pregnancy or of active inflammatory conditions in the adnexa. Such infections, if overlooked, may be "lighted up" into an acute condition by any pelvic operation, however trivial.

The patient having been placed in the lithotomy position and the exposed parts suitably draped with sterile sheets (p. 1071), a vaginal retractor is introduced into the vagina to retract the posterior vaginal wall. The anterior lip of the cervix is grasped with two volsella forceps and the cervix drawn down towards the vulva to admit of inspection. A sound may now be passed into the uterus to mark the length of the cavity and the direction of the canal. Graduated dilators, dipped in weak lysol solution or glycerine, are then gently introduced one after the other. The use of force is to be deprecated as it may easily cause a splitting of the cervix, which may extend through the internal os and involve the body of the uterus: this accident may be associated with very severe hæmorrhage.



FIG. 430.—Cervical Dilator. This pattern is more convenient than single Hegar dilators.

For most purposes dilatation up to No. 12 Hegar (*i.e.* 12 mm. or about $\frac{1}{2}$ in. in diameter) is sufficient. Where, as in cases of abortion, it is desired to introduce the finger a further dilatation up to about 18 Hegar may be required; this is usually difficult to accomplish and

particular care must be exercised to avoid tearing the soft cervix. The cervix, especially in nulliparous women, is more easily dilated either immediately before or immediately after a menstrual period.

Although it is usually a simple procedure, dilatation may be very difficult owing to rigidity and to the point of the dilator being caught by the ridges of the cervical mucosa. In such cases the greatest care must be exercised to avoid laceration, and this can be done by introducing the dilators gently and slowly and by allowing each dilator to remain in the canal for some seconds. To estimate the amount of pressure being exerted by the dilators against the cervical canal, it is advisable that the volsella be held by the operator himself. Another danger is *perforation of the uterine wall*, and this risk is greatest in cases in which the uterine body is sharply flexed upon the cervix, for example, acute ante flexion. The smaller and more narrowly pointed dilators may easily pass straight through the posterior wall of the uterus immediately above the level of the internal os instead of being directed forwards into the cavity of the uterus. Many cases in which the operation is being performed for spasmodic dysmenorrhœa are associated both with a rigid cervix and acute ante flexion; therefore particular caution must be observed.

CURETTAGE OF THE UTERUS

The curette is an instrument for scraping off the endometrium lining the cavity of the uterus and cervical canal. There are two kinds of curette: the scoop curette which is just a narrow, elongated,

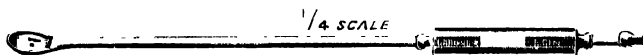


FIG. 431.—Flushing Blunt Curette

sharp spoon, and the loop curette, which again may be either sharp-edged or blunt-edged. The sharp loop curette is more commonly used, but a blunt flushing curette is preferable in cases of incomplete abortion

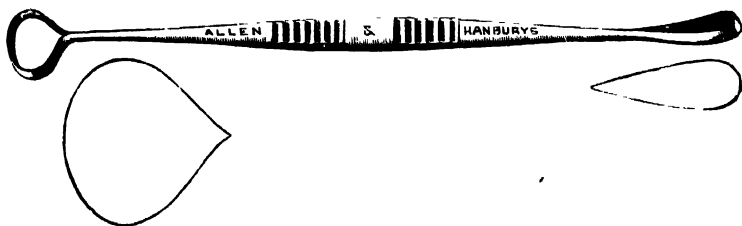


FIG. 432.—Sharp Loop Curette.

where the cervix is not sufficiently dilated to admit the finger, which is always the best and safest "curette" in such circumstances. Some operators use a sharp flushing curette (the hollow handle being connected with the rubber tubing of a douche can), and in this way wash

the tissue out of the uterus. If the ordinary loop curette is employed the uterus can be gently swabbed out to remove any fragments. It is not necessary to douche the uterus except in cases of abortion.

The operation of curettage was formerly, and is perhaps still, too frequently used without there being any clear indication for it. Our increasing knowledge of the subject of functional uterine hæmorrhage is slowly tending to diminish the abuse of this operation. The correct indications for curettage are (1) *diagnostic*, and (2) *therapeutic*. Whatever the indications, the risks of the operation are infection and injury. The former may be reduced to a minimum by thorough antiseptic precautions, as already described, but, if these are not carefully observed, serious and even fatal infection may follow this simple operation. Injury may be caused in the preliminary dilatation as already explained and also by passing the curette through the wall of a soft uterus. Such perforation is particularly liable to happen in cases of abortion, where the uterus is unduly soft as a result of the pregnancy, and in cases of cancer. It is also more liable to happen to the small atrophic uterus of the woman past the menopause. In all such cases particular precaution should be exercised.

DIAGNOSTIC CURETTAGE is done most commonly to exclude or confirm a suspicion of cancer of the endometrium, or to obtain a portion of the endometrium for microscopic examination in cases of supposed functional hæmorrhage (metropathia hæmorrhagica). If thick opaque tissue comes away, further curettage is dangerous as malignancy is almost certainly present. Benign tissue is usually translucent in appearance. Diagnostic curettage may be carried out by what is termed a "Punch" curette—a specially small loop used for obtaining a mere strip of mucosa in cases of sterility or amenorrhœa. It may be used without anæsthesia.

THERAPEUTIC CURETTAGE is done in cases of incomplete abortion, in some cases of functional hæmorrhage and for the removal of a

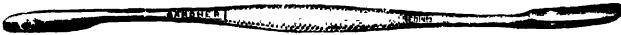


FIG. 433.—Scoop Curette (Martin).

mucous polypus. For therapeutic purposes the curettage must be thoroughly carried out. The loop curette should be used first, and long sweeping strokes from above downwards should be made right round the whole surface of the cavity. The fundus should then be scraped from side to side; and, lastly, any fragments left by the loop curette may be conveniently removed by scraping transversely round the cavity of the uterus with the scoop curette (Fig. 433). The interior of the uterus should then be wiped out with a thin piece of gauze held by uterine dressing forceps, and the cavity finally swabbed out with surgical spirit or weak tincture of iodine. *Care must be taken to remove endometrial tissue only; if the curettage is carried out too*

firmly removal of muscle tissue will result. It is important not to remove the basal portions of the endometrial glands imbedded in the muscle from which the subsequent regeneration of the mucosa will take place. *Too radical a curettage has sometimes resulted in complete cessation of menstruation.* It is unnecessary to pack the uterus unless there is undue loss of blood. However, when the operation is being done for dysmenorrhœa, it is often helpful to pack the cervical canal tightly and to leave the packing in for twenty-four hours to aid in more permanent dilatation.

All pieces of tissue removed should be placed *immediately* in a small bottle containing 5 per cent. formalin or Zenker's solution and sent to the pathologist for examination. Delay in preserving the tissue will render impossible an accurate histological report.



FIG. 434.—Uterine Flushing Catheter

Perforation of the uterus by dilator or curette is much more easily caused than is usually realised. It is particularly liable to occur if curettage is employed (*a*) in a heavily infected uterus : (*b*) in extensive malignant disease of the body of the uterus : (*c*) in vesicular mole : (*d*) in incomplete abortion. If the interior of the uterus is not infected, there may be no bad results : but if infection is present, then there is an obvious risk of peritonitis. The perforation may involve some relatively large vessel and lead to excessive hæmorrhage : in such cases the proper procedure is to open the abdomen at once and either control the bleeding by suture or remove the uterus. If the hæmorrhage is slight, packing the uterine cavity with gauze for twenty-four hours will suffice. Should peritonitis develop removal of the uterus is indicated.

Where the curettings confirm the diagnosis of malignancy in the body of the uterus, abdominal operation for its removal may be proceeded with at once, provided the patient has been suitably prepared for the major operation. Should this be determined upon, it is well to close the external os with strong sutures before proceeding to perform hysterectomy.

CHAPTER LV

PLASTIC OPERATIONS ON CERVIX, VAGINA, VULVA AND PERINEUM

CERVIX

AS we have pointed out in preceding chapters, the cervix is peculiarly exposed to trauma during labour with the production of a chronic inflammation, which is associated with leucorrhœa, persisting pelvic pain and ill-health. Further, the chronicity of the lesion may be a factor behind the high incidence of carcinoma in this region (p. 961). Active treatment of such cervical lesions thus constitutes a gynaecological procedure of great importance to health and life.

We have seen that many such lesions are best treated by means of diathermy (p. 914): but where the trauma and infection are marked, repair of the cervix (trachelorrhaphy), or amputation where the cervix is enlarged, may be necessary. In certain circumstances total hysterectomy by abdomen or vagina may be advisable.

As a preliminary to all operations on cervix and vagina a very thorough cleansing and disinfection of these areas should be carried out. Antiseptic vaginal douching should precede all operative procedures for two or three days. When the patient is anæsthetised and in the lithotomy position, the vulva, vagina and cervix should be cleansed as already detailed (pp. 1057, 1058). The cervix is drawn down by volsellæ and all mucous secretion cleared away with the aid of a solution of bicarbonate of soda: the cervix is again treated with the antiseptic chosen. We stress this thorough preparation as infected mucus may lead to early separation of catgut stitches with resultant secondary hæmorrhage. The cervix heals slowly and sutures should be strong (20-day strength), and preferably the catgut should be chromicised.

Trachelorrhaphy (repair of a lacerated cervix) is carried out when the cervix is torn but not hypertrophied. The tear may be bilateral or unilateral. The operation is most successful when there is no deep infection of the cervical tissues: and, as it does not shorten the cervix, it is the procedure indicated in younger women.

(a) *Emmett's Trachelorrhaphy*.—The cervix is held by volsellæ and dilated. The laceration is incised so as to get beyond the scar tissue at the upper angles of the tear, and the scar tissue is then excised. On either side of the cervical canal areas of mucous membrane are dissected off the everted lips of the cervix, leaving a narrow strip of

mucosa in the middle line to form the restored canal (Fig. 435, A). Catgut stitches are then inserted from the lateral aspect of the cervix in such a way that no dead space is left between the united lips (Fig. 435, B). If the laceration is unilateral one side only is dealt with.

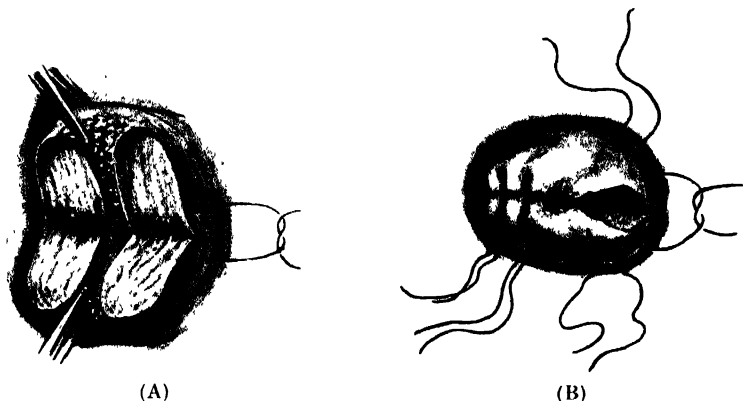


FIG. 435.—Emmett's Operation.

Unless there is definite indication, curettage of the uterus should not be carried out.

(b) *Bonney's Trachelorrhaphy*.—Though this method shortens the cervix slightly, the operation is a useful one and gives good results.

The cervical canal is dilated, and the whole exposed mucous

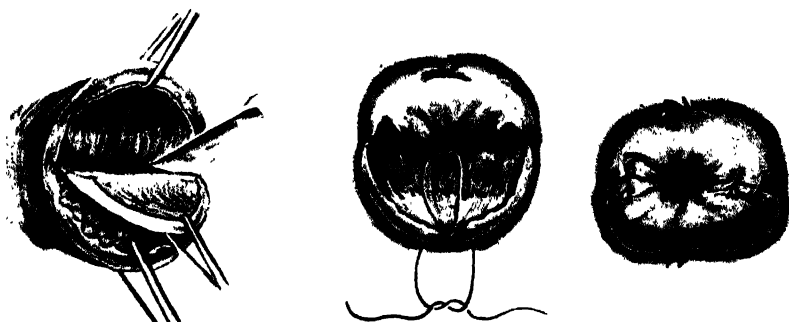


FIG. 436.—Trachelorrhaphy.

membrane is dissected off from each lip of the cervix up to the angle of laceration. Only mucosa is removed along with the scar tissue at the angles. The everted lips are now turned in towards the cervical canal by strong catgut sutures, inserted as in Fig. 436. The lateral margins are accurately approximated by stitches placed deeply enough to control all bleeding. Ribbon gauze is inserted into the cervical canal and removed in twenty-four hours.

Amputation of the Cervix.—This operation is performed when the cervix is hypertrophied in either its vaginal or supravaginal portion. Elongation of the latter portion is frequently associated with uterine

prolapse and is dealt with as part of the operation for that condition (p. 1102): here we deal only with hypertrophy of the vaginal portion.

Amputation of the vaginal portion may be performed by (a) flap method or (b) by circular amputation.

(a) *Flap Method of Amputation*.—This method is suitable when the vaginal portion of the lacerated cervix is both elongated and bulky. Anterior and posterior flaps of tissue are raised, the flaps consisting of vaginal mucous membrane and a thin layer of fibro-muscular tissue towards the base.

Volsellæ are applied to the cervical lips and the canal dilated. The lower limit of the bladder is identified by the use of a sound. The posterior flap is made first, its base being at the level of the intended

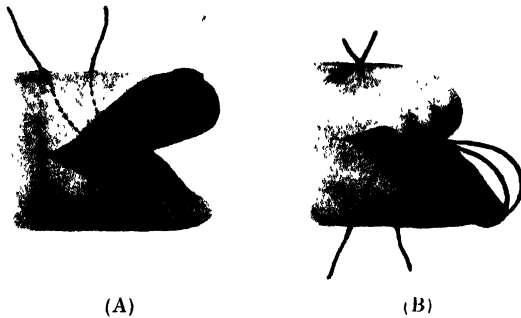


FIG. 437.—Amputation of Cervix by the Flap Method. (*Gynecology*. Eden and Lockyer.)

(A) Sutures placed ready to tie.

(B) Flaps turned in to the level of amputation of cervix; lateral suture controls hemorrhage.

amputation. The anterior flap is then made up to the same level. With the flaps reflected, the remainder of the cervix is amputated. Strong catgut stitches are then inserted on either side through the mucosa and the substance of cervical tissue, these being tied later. The apex of each flap is then sutured to the cut edge of the cervical canal, the sutures being inserted as in Fig. 437. The lateral sutures are then firmly tied, and others inserted, if necessary to control all oozing. A gauze strip is inserted into the canal and the vagina packed for twenty-four hours. From a bulky cervix bleeding may be free, but is usually checked by the tying of all the sutures. But occasionally a vessel of some size on the amputated cervix bleeds very badly: in such a case it is well to control the bleeding by understitching the vessel—it is generally impossible to ligate it. We would warn our readers of the necessity of ensuring complete hæmostasis.

Patients should be kept at rest for a fortnight in order to diminish the risk of secondary hæmorrhage from too early absorption of catgut. If such hæmorrhage occurs, resuturing under anæsthesia is the best treatment. Silkworm may be employed for safety, the sutures being removed three weeks later.

(b) *Circular Amputation.*—The cervix is drawn down and the canal well dilated. An incision is made in the mucous membrane round the cervix, half an inch above the external os; the mucosa is separated from the cervix and pushed upwards in the form of a cuff just beyond the level at which amputation is to be carried out (Fig. 454, p. 1102). In front the bladder may require to be dissected up from the cervix for a short distance. On each side of the cervix a deep stitch is placed to control the descending branches of the uterine vessels. The cervix is cut straight across and the stump secured with volsellæ. The cuff of mucous membrane is now stitched over the cervical stump, the sutures being placed in a radial manner. Steps must be taken to ensure the cessation of all bleeding.

This method should be reserved for those cases in which the cervix is elongated but little enlarged in bulk.

VAGINA AND PERINEUM

Anterior Colporrhaphy.—This procedure is described in the next chapter in connection with the operation for prolapse. It will be understood that it can be readily performed without amputation of the cervix when this is unnecessary.

Posterior Colporrhaphy and Perineorrhaphy.—Repair of lacerated perineal tissues is frequently called for even though actual vaginal prolapse is absent, but some excess of stretched vaginal wall also falls to be removed. In many cases imperfect healing of a “torn perineum” resulting from labour leads to the advisability of these reparative procedures.

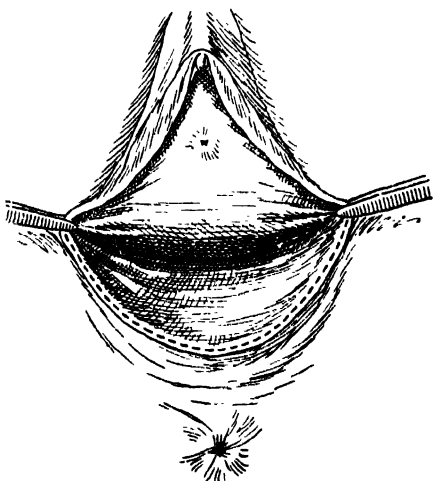


FIG. 438.—Colpo-perineorrhaphy.
(First stage.)

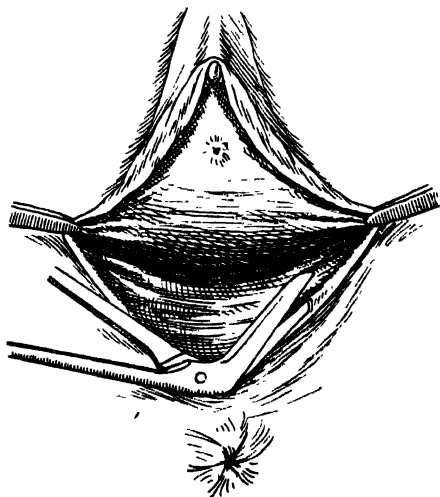


FIG. 439.—Colpo-perineorrhaphy.
(Second stage.)

Colpo-perineorrhaphy.—Tissue forceps are applied on either side of the wide vaginal orifice at the base of each labium minus and exactly

opposite each other (Figs. 438, 439). A knife then removes a thin strip of skin at the muco-cutaneous junction from one forceps to the

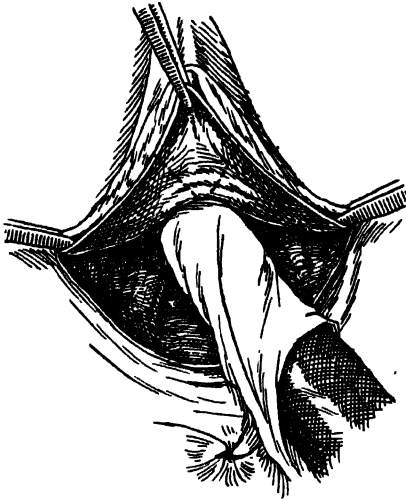


FIG. 440.—Colpo-perineorrhaphy.
(Third stage.)

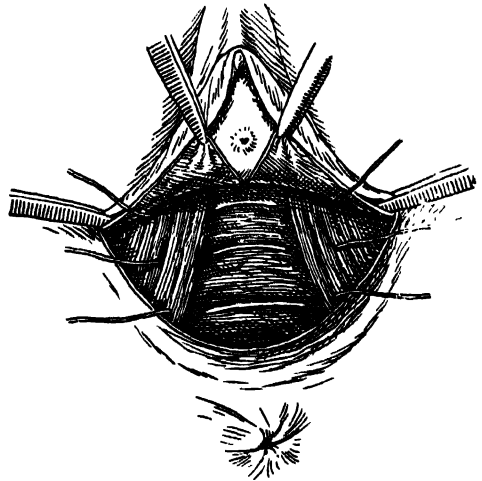


FIG. 441.—Colpo-perineorrhaphy.
(Fourth stage.)

other. The mucous membrane of the posterior vaginal wall is dissected off the anterior wall of the rectum, partly by scissors and partly by

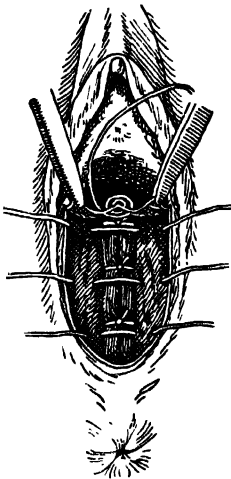


FIG. 442.—Colpo-perineorrhaphy.
(Fifth stage.)



FIG. 443.—Colpo-perineorrhaphy,
showing subcutaneous stitching
of skin.
(Sixth stage.)

gauze pressure. The operator must dissect close to the vaginal wall in carrying out this step in order not to injure the rectum. (If the

limits of the rectum are in doubt, a large dilator may be gently inserted into the bowel through the anal orifice—a step which will aid the inexperienced operator.) The mucosal flap should be freed laterally as well as centrally (Figs. 440, 441). A wedge-shaped piece of vaginal mucosa may now be removed, care being taken to remove only as much as is really necessary; it is better to remove too little than too much (Fig. 440). Hæmorrhage is mainly venous, and is usually controlled by pressure with a hot moist swab, but bleeding points should be ligated. The cut vaginal wall is then repaired in the mid-line with interrupted or continuous (Fig. 442) catgut sutures.

The next step consists of the insertion of two or three strong catgut sutures into the levatores ani, which have been exposed by the original dissection, care being taken to avoid injuring the bowel as the needle passes across from one levator muscle to the other (Fig. 441). If the original trauma has been severe and a large rectocele is present, the levatores ani may have to be sought for wide out behind the rami of the ischial bones. When the sutures are tied the muscles are brought firmly together, separating the vagina from the rectum and restoring adequately the support of the pelvic floor (Fig. 442). One or two thin catgut stitches may be inserted to approximate the subcutaneous tissues, and the skin is then sutured by a fine subcuticular catgut stitch (Fig. 443) or (and this is a safer procedure) by interrupted silkworm stitches.

Complete Laceration of Perineum.—When this has occurred the tear may have involved the sphincter ani only or the wall of the anal canal and rectum may have been torn for some distance (*cf.* Figs. 438 and 444).

The primary steps of the operation are the same as those just described, but in addition the incision is carried back on either side to expose the separated ends of the sphincter ani (Fig. 445). The incision then becomes H-shaped, as depicted. Separation of the vaginal from the rectal wall is then very carefully carried out. The rectal wall may be repaired in one of two ways. Either interrupted catgut sutures are inserted and knotted in the lumen of the bowel from above downwards (Fig. 445), or the bowel wall may be repaired by a fine catgut continuous suture inserted in Lambert fashion, the edges of the rectal wall being turned in towards the lumen. The ends of the anal sphincter are then sought for and brought together by a couple of sutures (Fig. 446). The rest of the operation is carried out as in the procedure for colpo-perineorrhaphy; but, as the bowel is being repaired and strict asepsis therefore impossible, the levatores ani should be brought together not with catgut, but with silkworm sutures inserted in "figure of eight" fashion and tied on the perineal skin surface. One of the silkworm sutures may with advantage be placed through the sphincter muscle.

After-treatment.—The perineal area must be kept clean and as dry

as possible, and the bowels should not be stimulated to move for six or seven days in cases of complete perineal tears. In other cases they may be moved on the fourth day. It is advisable to prescribe a diet with the least possible waste content. An injection of olive oil may be given prior to the first bowel movement. Such an injection must be given with the greatest care in order that the sutured rectal wall will not be injured : it should, therefore, be given with a lubricated rubber catheter.

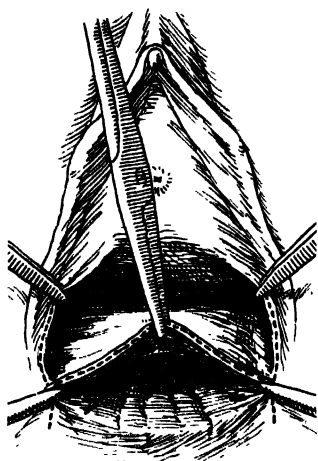


FIG. 444.—Operation for complete Tear of the Perineum. Dissection of vaginal wall from bowel wall along dotted line so that there is an upper vaginal flap and lower rectal flap of mucous membrane as shown in next figure.

(First stage.)

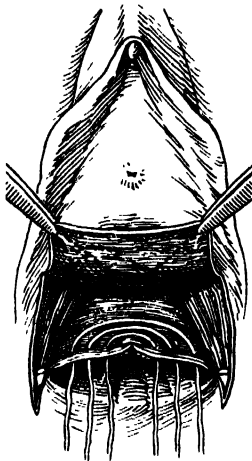


FIG. 445.—Operation for Complete Tear of the Perineum. Vaginal wall is shown pushed up and wall dissected off rectal wall. The rectal stitches are shown inserted but not yet tied; when they are tied the knots will be inside the rectum.

(Second stage.)

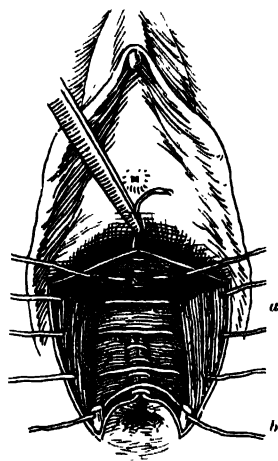


FIG. 446.—Operation for Complete Tear of the Perineum. Rectal stitches have been tied. Untied stitches (a) coapt levator ani muscles and cellular tissue; (b) coapts torn levator ani muscle. Completion of repair as shown in Figs. 442 and 443.

(Third Stage.)

Operations for Vaginismus and Dyspareunia. When the vaginal introitus is unduly narrow and firm it may be stretched thoroughly under anæsthesia. Thereafter, graduated tapered glass dilators should be inserted into the vagina twice daily for twenty minutes. *It is essential that the patient herself inserts the dilators after the first day or two, for thereby the patient gains confidence. Unless confidence is gained success will not follow the treatment (p. 812).*

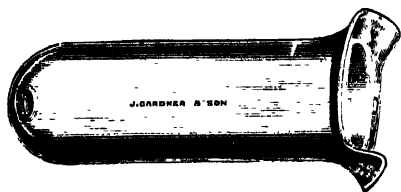


FIG. 447.—Vaginal Dilator.

In cases of vaginismus, incision and suture should always be avoided unless vaginal dilators fail, but in a few cases the operation of perineotomy will have to be carried out. A vertical incision is made

through the posterior commissure and the incision stitched up antero-posteriorly. The introitus vaginæ is thus enlarged (Figs. 448, 449).

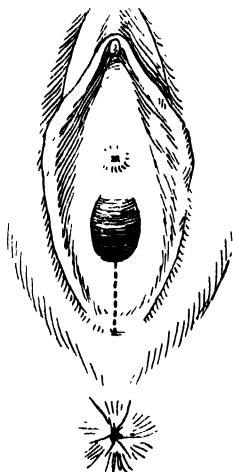


FIG. 448.—Operation
for expanding Vaginal
Inlet.
(First stage.)

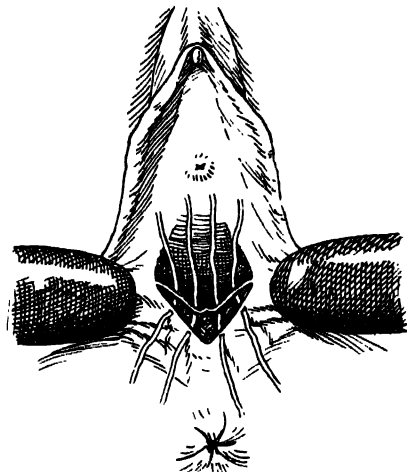


FIG. 449.—Operation
for expanding Vaginal
Inlet.
(Second stage.)

Vesical Fistulæ.—Vesico-vaginal and vesico-cervical fistulæ are generally the result of obstetric injury ; they are usually associated with scar tissue, the result of infection, which almost necessarily follows severe trauma at labour. Fistulæ resulting from operative procedures may have little accompanying infection ; consequently many heal spontaneously or by simple suturing, if the bladder is kept drained by a self-retaining catheter.

In most cases the fistula can be dealt with from the vagina ; but in a few instances the high site of the fistulous opening demands operation by the abdominal route, a transvesical procedure being adopted. It is most important that any bladder and urinary infection present be treated adequately prior to operation. It is worth noting that grave bladder infection is not much in evidence in these cases, presumably owing to free drainage through the fistulous opening.

Vesico-vaginal Fistula.—Very small fistulæ may be dealt with by paring the edges, others require a flap-splitting procedure.

(a) *Paring the Edges.*—The cervix is drawn down by volsellæ and the bladder washed out. Allis' forceps are placed above and below the fistula and the vaginal mucous membrane incised right round the opening at a distance of from quarter to half an inch. This circular piece of mucosa is dissected off the bladder wall, and so the margins of the opening are necessarily pared. Stitches are then placed to draw the cut vaginal mucous membrane together, each stitch passing through the muscle wall of the bladder just beyond the fistula on either side. When tied, the stitches invaginate the fistulous opening in a Lembert

fashion and close the vaginal incision. They may be inserted from side to side or from above downwards, according to the direction of least tension.

(b) *Flap Splitting*.—This procedure is necessary when the fistula is large. In some instances it may be advisable to have ureteric catheters inserted through the urethra in order to avoid stitching the ureteric opening if it is close to the fistula. The catheters may, however, be difficult to pass in these cases.

An elliptical-shaped incision is made a little way from the opening, and a flap of vaginal mucous membrane, including the fistulous

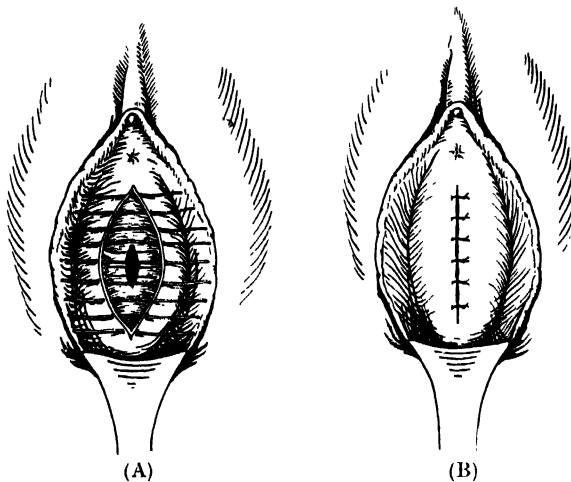


FIG. 450.—Repair of Vesico-vaginal Fistula by the Flap-splitting Operation.

(A) Sutures in position through the vaginal wall; the fistula is closed by interrupted sutures which traverse the muscle wall of the bladder but not through the bladder mucous membrane.
(B) Sutures tied—vaginal wall closed over sutured fistula.

opening, is raised up from the bladder wall. The margin of the mucous membrane is then undermined, separating it from the bladder wall for a short distance. Oozing of blood may be controlled by hot swabs, but one or two vessels may have to be ligated. The fistula is then closed by a purse-string suture or interrupted sutures which do not pierce the bladder mucosa. The part of the vaginal flap containing the fistulous opening is now cut away and the flap sutured back over the repaired bladder. If tension is marked, relaxation incisions into the vaginal mucous membrane may be made lateral to the stitched area; these may be stitched at right angles to the line of incision or may be left, in difficult cases, to heal by granulation. Continuous drainage of the bladder is required for a week or so, an ounce of argyrol being run in daily. It is common to nurse the patient in the recumbent position, but excellent results follow nursing in the prone position, and patients are comfortable lying in this manner for some days.

Vesico-cervical Fistula.—The commonest form is associated with a deep laceration of the vaginal portion of the cervix, the bladder

communicating with the open cervical canal. The fistula may be closed at the time when the cervical injury is repaired. In rarer cases the fistula communicates with the supra-vaginal portion of the cervix and can only be reached by an incision similar to that employed as a preliminary to vaginal hysterectomy (p. 1119).

Uretro-vaginal Fistula.—This fistula is best treated from the abdomen and reimplanting ureter into bladder.

Recto-vaginal Fistula.—This is usually low down in the vagina and is associated with a partly healed perineal tear (p. 605). It is best dealt with by deliberately cutting through the remains of perineum into the rectum and dealing with the condition as a complete perineal tear.

When situated high up in the vagina the treatment is on the same principles as for vesico-vaginal fistulæ. The anal sphincter should be overstretched before and after operation.

Lefort's Operation for Prolapse.—This operation is very rarely employed. It may be justified in old women in whom the uterus has undergone atrophy or has previously been removed and in women suffering from extensive prolapse of the vaginal walls in whom marital relationships have ceased to exist. After removing a rectangular strip of mucous membrane from the vaginal walls from the cervix downwards, the two raw surfaces are apposed by sewing them together from above downwards. This ensures a strong mesial partition between the two narrow canals on each side. The strip removed should be about three inches long by half-an-inch wide.

For pronounced cases of procidentia there are the alternative procedures: (a) Plastic repair (p. 1101), (b) Vaginal hysterectomy (Mayo's Operation) (p. 1104).

Repair of Sphincter of Bladder.—We have referred elsewhere (p. 603) to injury to the sphincter of the bladder and to the most troublesome "stress incontinence" which so frequently results. Several procedures for correcting the condition have been suggested. The simplest is to dissect off a diamond-shaped area (1 to 1½ in. wide) from the vaginal mucous membrane at the junction of urethra and bladder. With fine chromicised-gut stitches the fibro-muscular tissue on either side is stitched together under the neck

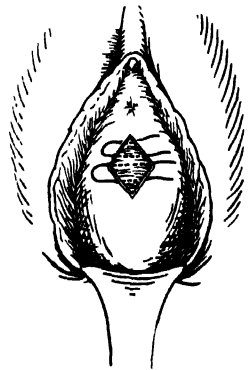


FIG. 451.—Operation for tightening-up the sphincter of the bladder in cases of stress incontinence.

of the bladder in the middle line to restore adequate support. The edges of the mucous membrane are then united. This procedure is frequently necessary as part of the operation for cystocele.

CHAPTER LVI

OPERATIONS ON THE UTERUS

Operations for Prolapse of Uterus—Operations for Backward Displacement of the Uterus—Operations for Inversion of the Uterus—Myomectomy—Abdominal Hysterectomy—Vaginal Hysterectomy—Plastic Operations for Malformations of Uterus

OPERATIONS FOR PROLAPSE OF UTERUS

THE principles underlying the surgical treatment of prolapse of the uterus and vaginal walls have been summarised in Chapter XLIV (p. 847). The operations for prolapse of the vaginal walls have been described in the preceding chapter. We have now to consider the methods applicable to prolapse of the uterus itself.

Prolapse of the uterus implies descent of that organ and almost without exception elongation of the supravaginal cervix. The essential supports of the uterus are elongated. The relationship of the bladder to the uterus makes it inevitable that the bladder descends with it and with the anterior vaginal wall which comes down in front of the bladder (cystocele). In many cases this element is very pronounced, so that there is marked protrusion, a sort of ballooning out of the anterior vaginal wall and bladder. The intimate attachment of bladder and upper urethra to anterior vaginal wall explains this. It has been pointed out that cystocele may occur without descent of the uterus (p. 843). Again, the lateral halves of the pelvic diaphragm (muscular sheet and fascias) are usually widely separated and the perineal body deficient in its support as a result of laceration, thus the vaginal canal and vaginal orifice are widened. Usually there is redundancy of both anterior and posterior vaginal walls.

All these features must be borne in mind when operating for prolapse of the uterus. The operation in principle is the same in all cases, but is modified to conform to the extent to which each of the above elements mentioned is present—(a) amputation of the cervix restores the cervix to normal length; (b) the essential supports of the uterus are shortened enough to elevate the uterus to its proper level in the pelvis; (c) the bladder is returned to its normal situation partly by being carried up with the uterus but also by shortening its own supporting structures; (d) the separated edges of the pelvic diaphragm are brought together and the perineal body is reconstructed. In the course of the above procedures redundant vaginal wall to the extent to which it is present is removed. As a result the vaginal orifice

and vaginal canal in its complete length are narrowed to a limit short of preventing coitus.

Furthermore, the extent of the various procedures is influenced by the age of the woman. If she is in the child-bearing period, amputation of the cervix should be of minimal extent as, if overdone, abortion in a subsequent pregnancy or dystocia in a subsequent labour may occur. It is better to prevent the occurrence of abortion and difficult labour with laceration of superficial tissues and deep supports than to attempt to ensure that the prolapse will not recur. *Pregnancy*

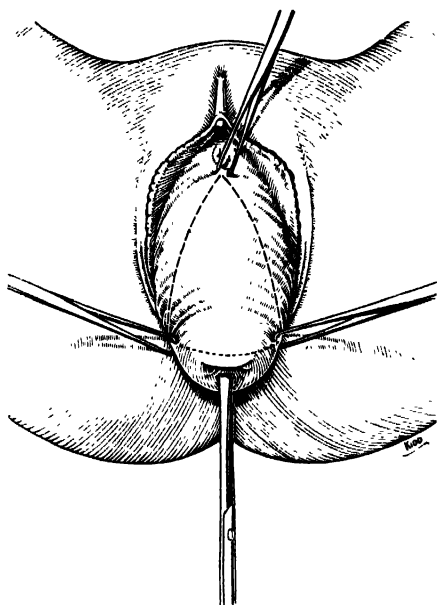


FIG. 452.—Operation for Prolapse.
(First Stage.)

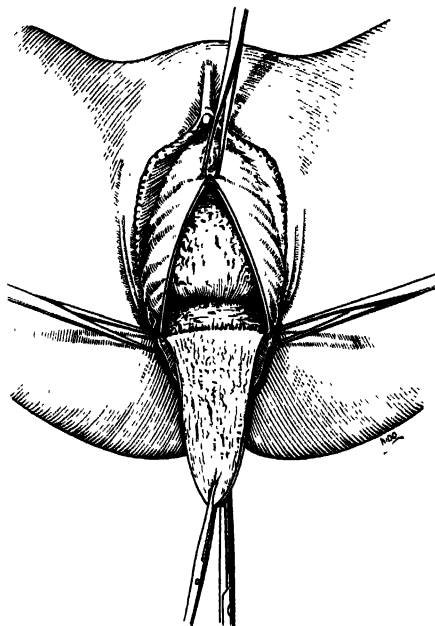


FIG. 453.—Operation for Prolapse.
(Second Stage.)

The alternative method of detaching vaginal mucous membrane from bladder wall is by means of scissors pushed up between these structures. By separating the blades the dissection is made.

and labour after the operation is a definite aetiological factor in recurrence, and when this takes place the prolapse often takes a form quite different to the original. While descent of the uterus was the main feature in the original prolapse, in recurrence, cystocele with or without lacerated perineum is frequently encountered and with the uterus at normal level.

The operation seems complicated but in reality is simple, and because of wide scope for its employment is one of the most beneficial plastic surgical procedures carried out at the present day.

Donald, of Manchester, was the first (1888) to practise the principles of this operation. Fothergill (1895), of the same school, introduced the method of performing anterior colporrhaphy and amputation of the cervix as one procedure and popularised the operation. *They emphasised that free lateral dissection, because it inevitably brings the*

paracervical tissue across in front of the cervix, and amputation of the cervix were the two important principles. Only comparatively recently, however, has it been recognised that this method of operating has eliminated the necessity for operating by the abdominal route.

For certain displacements operations involving laparotomy will be described later; but the student will please note that not one of these is designed primarily for prolapse.

Operative Procedure for Prolapse.—The operation, usually referred to as the Donald-Fothergill or Manchester operation, is carried out as follows. After the recognised preparation the cervix is pulled down by volsellæ (Fig. 452), a triangular area of the anterior vaginal wall is

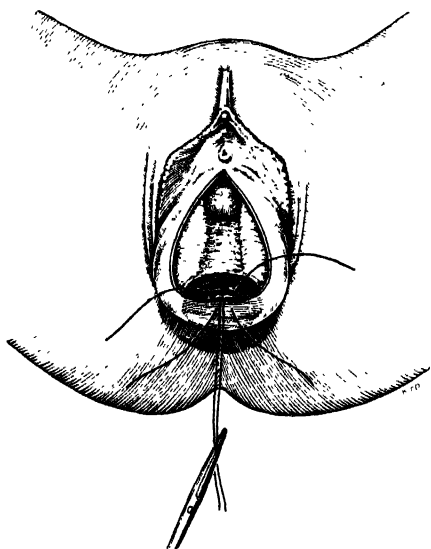


FIG. 454. Operation for Prolapse.
(Third Stage.)

marked off with tissue forceps at the angles. The apex of the triangle is just above (towards cervix) the urethral orifice and the base across the cervix. An incision is made on either side from the first point to the sides of the cervix, and is then carried round the posterior aspect of the cervix. The anterior vaginal mucous membrane is dissected from the bladder and cervix commencing at the urethral end or apex of the area marked off (Fig. 453). When separated clear of the bladder, the latter is pushed up by gauze pressure after it has been freed by a light transverse incision. The cervix is then amputated, and to it there is at-

tached the superfluous anterior and posterior vaginal walls. Commencing in the mid-line posteriorly the cut edge of vaginal wall is stitched so that it covers the raw surface of the cervical stump and its edge comes to the new external os (Fig. 454). Working thus from the posterior aspect towards the front of the cervix, the sutures take in not only mucous membrane but the underlying tissue as well. This is most important as the anterior aspect is approached where the underlying tissues (paracervical) are drawn across in front of the cervix (Fig. 455). The shortened uterus is now seen to be receding upwards into the pelvis. There remains a gaping wound extending from the cervix to near the urethral orifice. This is closed from the cervical extremity. Deep to the vaginal mucosa and between it and the bladder there are valuable supporting tissues—the paracervical tissue at the cervical end and forward of this a sheet of fibrous tissue and smooth muscle which runs from the cervix to the pubes below the bladder. Buried sutures may be employed to bring

these structures across (Fig. 455) below the cervix and bladder, or they may be included in the stitches employed to approximate the edges of the vaginal wall. The uterus rises to a still higher level as this is done. The operation is completed by removal of any redundant posterior vaginal wall, approximating the edges of the levatores ani muscles and reconstructing the perineal body as is necessary, and as described in preceding pages (pp. 1093 *et seq.*). This last step has no influence in restoring the uterus to its normal level; it merely aims at additional support and narrowing of the canal through which the uterus herniated.

Many variations in the steps of this operation are practised. For instance, it is a common procedure to dissect the anterior vaginal wall

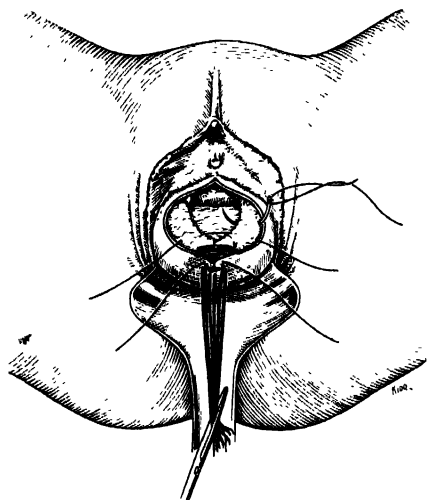


FIG. 455.—Operation for Prolapse.
(Fourth Stage.)

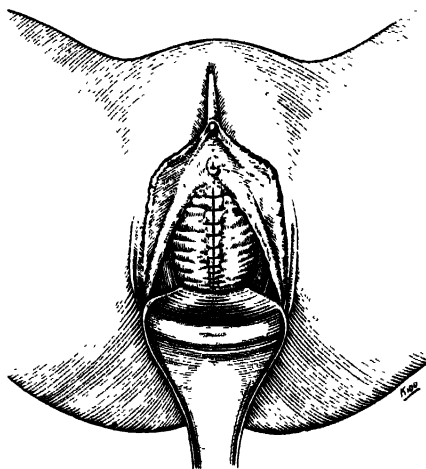


FIG. 456.—Operation for Prolapse.
(Completed.)

from the bladder commencing at the cervical end with scissors (Fig. 452, p. 1101), thereafter the cervix is amputated. Whatever method is favoured, the principles are the same, and if these are followed the results are good.

Mention may now be made of some special points in connection with this operation. It is advisable always to dilate the cervix and explore the uterine cavity with the curette. Dilatation of the cervix makes the suturing around the new external os much easier and curettage gives one confidence that there is no pathological condition of the endometrium of the body or cervix. Occasionally a polypus is removed from the uterine cavity. Early cancer of the body of the uterus has been discovered when hæmorrhagic discharge was thought to be due to ulceration of the prolapsed mass. In very elderly subjects dilatation of the cervix should not be carried farther than will permit of introducing a very small size of curette. The cervix of the atrophic uterus is easily ruptured with metal dilators.

Operation should never be undertaken if there is ulceration of the

vaginal wall or cervix, if the vaginal walls are thick and leathery in character or if the prolapsed mass is swollen and œdematous. Two to three weeks' rest in bed with the mass returned to its normal position will eliminate all of these conditions, will make the operation easier to perform and will make certain of a good result. A cup-and-stem pessary is sometimes employed to obviate this period of rest; but it is not a good substitute, as infection of vagina and cervix is thereby maintained; besides, the patient's general condition is benefited by rest before operation.

Sometimes prolapse becomes manifest very soon after a confinement. It is unwise to operate too early. Involution of the uterus and all other structures should be complete before operation is carried out. The minimum limit of time from a confinement should be six months. This operation should not be carried out following labour or during the puerperium as has been suggested.

Vaginal Hysterectomy for Prolapse.—Vaginal hysterectomy for prolapse, as favoured in America, has found a few supporters in this country. Naturally, vaginal hysterectomy has on occasion to be performed where the uterus is diseased and would have been carried out even if there had not been a prolapse. That prolapse simplifies vaginal hysterectomy is not an indication for its performance. By removal of the uterus it is contended that reconstruction of the supports in the pelvis is made easier and that the opening through which the uterus herniates can be completely closed. Even so, it does not necessarily follow that the support provided is any more efficient than when the uterus is not removed. Under all circumstances serious consideration should be given before removing the uterus previous to the menopause.

The removal of an unhealthy uterus in a case of prolapse may be advisable and we should therefore be prepared to restore the pelvic supports at the time of its removal.

The essential features of this operation are: (a) The uterosacral ligaments and parametric tissues from which the uterus has been severed are united across the pelvis; (b) that proceeding forwards from these the supporting structures of the bladder are approximated through the space available by removal of the redundant anterior vaginal wall with the uterus, just as in the Manchester operation where it is removed with the cervix only. (Vaginal Hysterectomy is described later, p. 1119.) The necessary repair posteriorly is the same as already described in the preceding pages (1093 *et seq.*).

Interposition Operation.—We describe and illustrate (Figs. 457, 458) another operation and one which demonstrates the ingenuity of the early gynæcologists in their efforts to find a cure for prolapse. It is not often employed, but the exceptional case may, however, occur in which one would feel justified in performing the operation—viz., a case of cystocele *without descent of the uterus*, a condition not uncommon in very elderly subjects. In these the supporting structures

of the bladder may be very deficient and difficult to restore. The object of the interposition operation is to employ the uterus to support the bladder. It is obvious that this is not a suitable operation if there is any descent of the uterus, as that organ cannot then support the bladder efficiently.

The anterior vaginal wall is incised and the bladder pushed upwards as in the preliminary stage of an anterior colporrhaphy (p. 1101). The separation of the bladder is continued until the peritoneum of

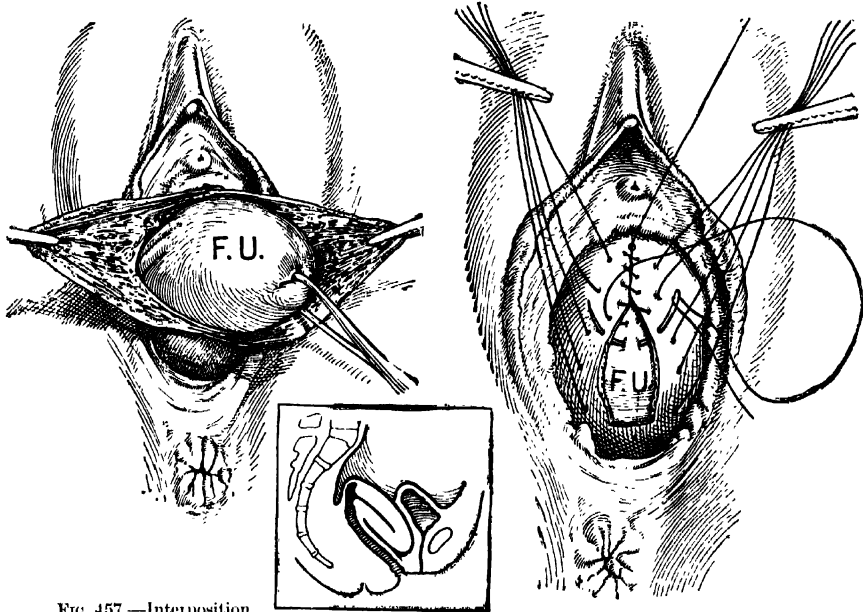


FIG. 457.—Interposition Operation. Fundus exposed through utero-vesical pouch.

The position of the uterus and bladder after the interposition operation.

FIG. 458.—Interposition Operation. Fundus being sutured to anterior vaginal wall.

the utero-vesical pouch is exposed to view. This is incised and by means of volsellæ the fundus is carefully pulled down (Fig. 457). The bladder is kept above the fundus and the anterior vaginal wall, after removing what is redundant, is sutured to the anterior surface and fundus of the uterus (Fig. 458). The altered position of the uterus with the bladder supported on its posterior wall is shown in inset.

This operation is satisfactory only in carefully selected cases. Obviously, it would not be performed before the menopause. Great care must be taken to avoid infection of the pelvic peritoneum—this is a definite danger as a little collection of blood is liable to occur in the dead space below the fundus.

OPERATIONS FOR BACKWARD DISPLACEMENT OF THE UTERUS

The principles of surgical treatment of backward displacement of the uterus have been discussed in Chapter XLIV (p. 855). The operations in favour are those in which the round ligaments are shortened so as to keep the uterus in anteversion. The other type of operation, ventral fixation, by which the posterior wall of the uterus is made to adhere to the back of the abdominal incision is not favoured so much to-day as formerly.

The Alexander-Adams Operation.—This is strictly an extraperitoneal operation; the peritoneal cavity is not opened. An oblique incision is made over the inguinal canal on either side, parallel to Poupart's ligament. The skin, fascia and aponeurosis of the external oblique

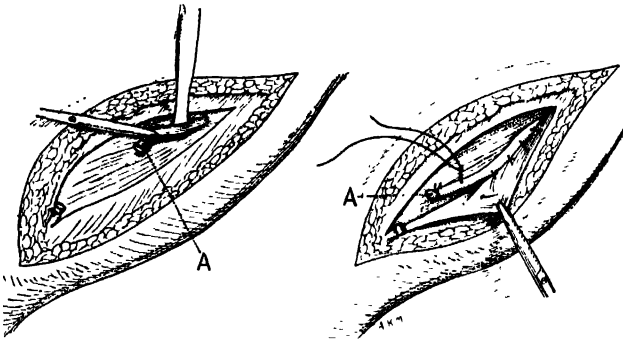


FIG. 459.—Alexander-Adams Operation. A, Round Ligament.

are divided and the round ligaments identified. The ligaments are then dissected free and pulled upon, thus bringing the fundus forwards. The superfluous portion of the ligaments is removed and the remainder (Fig. 459 (A)) fixed securely by including it in the stitches closing the incision in the aponeurosis of the external oblique muscle.

The operation should be employed only for uncomplicated movable backward displacement. If adhesions are present the operation fails completely. The possibility that the abdominal wall may be weakened at the position of the inguinal rings can be prevented by a complete obliteration of the whole inguinal canal.

Gilliam's Operation.—The abdomen is opened in the middle line. A Pfannenstiel incision may be used, thus giving wide access to the front of the sheath of the rectus muscle (p. 1062).

A stab incision is made through the rectus sheath, muscle and the peritoneum, about $1\frac{1}{2}$ inches from the middle line on either side, at or a little below the level of the anterior superior spines. Through these openings the round ligaments are drawn, either by looping them in a ligature or by the use of special forceps; the apex of the loop

should be about $1\frac{1}{2}$ inches from the uterine end of the ligament (Fig. 460 (1)). The ligaments are then drawn across the front of the rectus sheath and stitched to it firmly (Fig. 460 (2)). The abdominal incision is closed in the usual way.

This operation gives a better mechanical pull on the fundus than the Alexander-Adams operation, but it is open to the objection that the abdominal wall is weakened by the presence of two new openings. There is also a risk that a loop of bowel may become trapped between the uterus and the abdominal wall.

Various modifications of this operation are practised. In one, the procedure is carried out extraperitoneally but under direct vision through a mid-line incision. A slender curved forceps is pushed through a stab incision in the rectus sheath at the outer edge of the

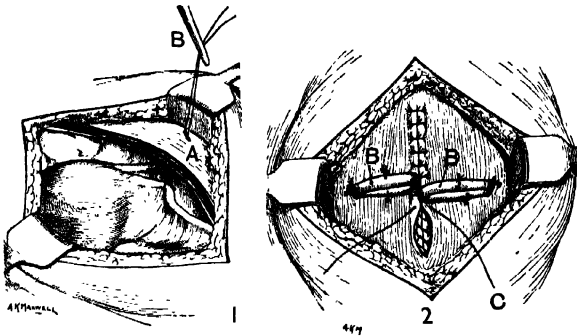


FIG. 460.—Gilliam's Operation.

rectus muscle. It is then guided under the peritoneum towards the internal inguinal ring, and from there between the layers of the broad ligament inwards along the track of the round ligament. About $1\frac{1}{2}$ inches from the uterus the peritoneum is penetrated, and the round ligament, by means of a ligature already cast round it, is drawn upwards and outwards to the rectus sheath where it is secured by suturing. In this modification there is no distortion of the anatomical arrangement, and there is less risk of a subsequent bowel complication, but care must be taken to avoid injuring the deep epigastric vessels when making the stab incisions, and the iliac vessels when passing the forceps towards the broad ligaments.

The Sling Operation.—This operation is also referred to as the Baldy-Webster operation. The abdomen is opened in the middle line. A forceps is then pushed from behind through the broad ligament, just below the ovarian ligament, and just far enough away from the uterus to prevent injury to the anastomotic vessel (Fig. 461). A loop of the round ligament is then drawn backwards through the broad ligament. This is repeated on the other side and the loops are

stitched to the back of the uterus *at a high level*; otherwise, the fundus may fall back over them.

This, like the last described, is a most satisfactory operation and gives rise to no difficulties in pregnancy. The correction of the uterus has been found to persist after pregnancy. It has the additional advantage that it supports the ovaries at a higher level. This is a great benefit when, as is common, prolapse of these organs is present.

Shortening of the Round Ligaments by Plication.—In this operation

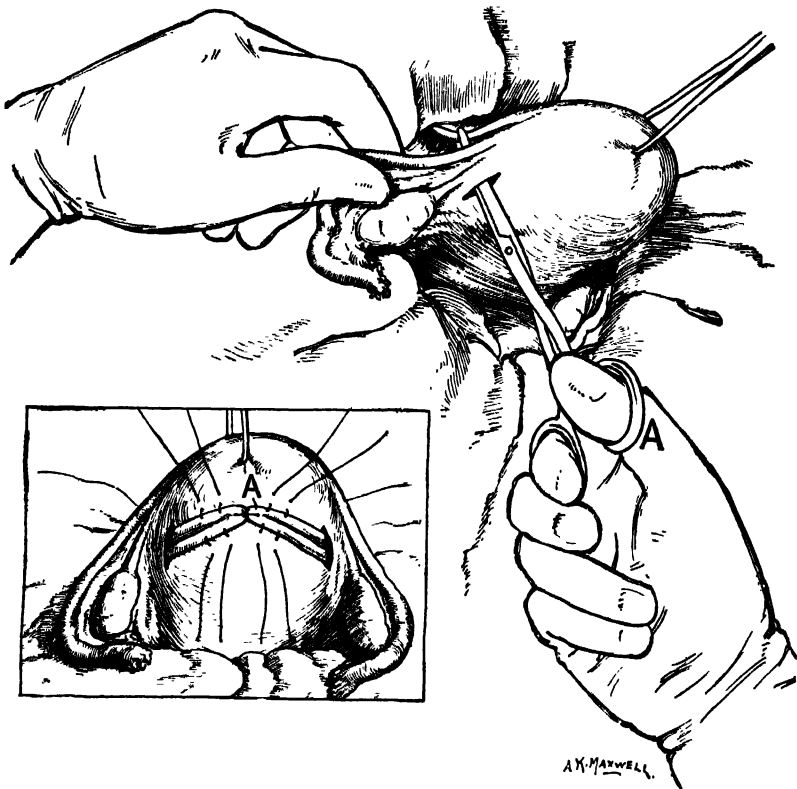


FIG. 461.—Sling Operation. Inset shows round ligaments pulled through broad ligaments and stitched to back of uterus.

the round ligaments are stitched down and along the antero-lateral border of the uterus, and then upwards towards the tubo-uterine angle. It is one of the earlier forms of round ligament operation, has no special advantages and is seldom employed.

Anterior Plication of the Broad Ligaments.—In this operation, often referred to as Coffey's operation, the anterior layers of the broad ligaments, including the round ligaments, are brought across the front of the uterus and are then stitched to its anterior surface. The operation has the disadvantage of employing what is really only a

loose fold of peritoneum, with an uncertain amount of connective tissue underneath, to act as a support, and such tissue is very liable to stretch under tension. The operation is employed by very few gynæcological surgeons.

Ventral Fixation or Hysteropexy.—Here the uterus is fixed to the anterior abdominal wall. The uterus is brought forwards and its anterior surface is scarified. Three fixing sutures are then inserted as follows: The uppermost suture passes through fascia, muscle and peritoneum, through the uterine substance, and then through the same layers of the abdominal wall on the opposite side. The middle suture is passed in the same way but leaves out the peritoneum. The lowermost suture is passed in exactly the same way as the uppermost one (Fig. 462). The alteration in the course of the middle suture in avoiding the peritoneum holds apart the peritoneum and allows the uterus to become directly adherent to the under surface of the rectus sheath instead of to the peritoneum, which is so liable to stretch.

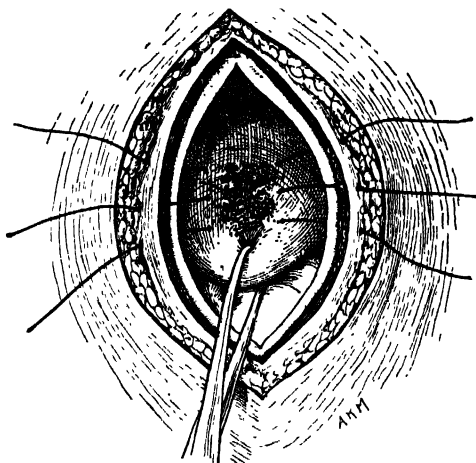


FIG. 462.—Ventral Fixation or Hysteropexy.

At one time this was a favourite operation in cases of prolapse with descent of the uterus, but it proved an unsatisfactory procedure and has been discarded. For backward displacement when operation is necessary, it has been replaced by ventro-suspension—*i.e.* shortening of the round ligaments.

Obviously it is not a suitable operation before the menopause unless the patient is sterilised at the time of operation. Retro-displacement *per se* practically never necessitates operative treatment after the menopause.

OPERATIONS FOR INVERSION OF THE UTERUS

The treatment of inversion of the uterus has already been described (p. 568). It is only when manual reposition has failed that a surgical operation should be undertaken. As reposition by means of Aveling's repositor (p. 864) even in the "chronic" cases is usually successful, surgical treatment merits only a very brief description, sufficient merely to indicate to the student the principles of the procedures employed.

OPERATION BY ABDOMINAL ROUTE.—The abdomen is opened in the usual way and the posterior edge of the constricting ring is incised

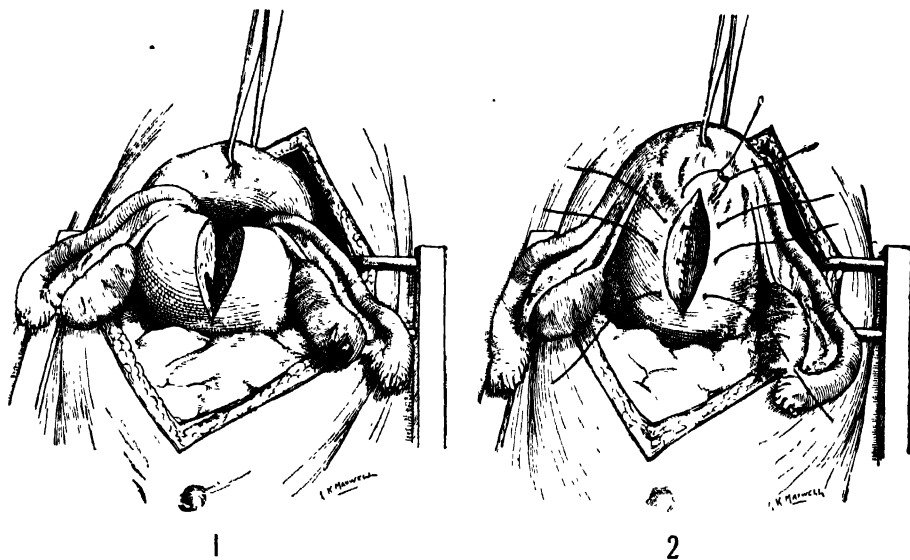


FIG. 463.—Operation for Inversion of the Uterus.

(Fig. 463 (1)). The fundus is then brought up by traction with volsellæ and should it be necessary by an assistant pressing it up from the vagina.

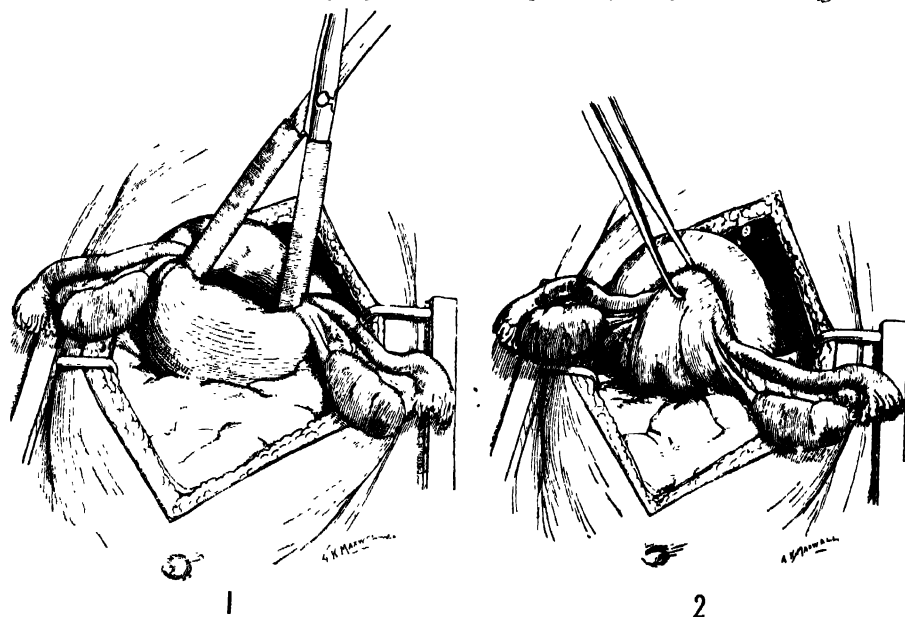


FIG. 464.—Operation by the Abdominal Route for Inversion of the Uterus.

The incision in the posterior wall to relieve the constriction is then sutured (Fig. 463 (2)). With much manipulation pelvic infection is liable to occur.

Instead of incising the ring the operator may try to overstretch it by means of a pair of stout, rubber-covered clamps, as shown in Fig. 464 (1 and 2). The fundus is then drawn upwards with a volsellæ and at the same time pushed upwards from the vagina by an assistant. This, however, may present difficulties and is often unsuccessful, necessitating incision as already described.

OPERATION BY VAGINAL ROUTE.—This operation is associated with the name of Spinelli. The anterior wall of the uterus is divided in the middle line from external os to fundus. The inversion is corrected and the incision sutured. It is a complicated operation. The bladder is liable to be injured, and pelvic infection readily follows as the inverted fundus is always infected.

MYOMECTOMY

This consists of the enucleation of a fibromyomatous tumour or tumours from the uterus to restore the normal condition and function of that organ. Large size of tumour is not a contra-indication to this operation. The operation is in fact extensively employed when the tumour is large but is conveniently placed for enucleation. It is also carried out frequently when the tumours are multiple. In visualising myomectomy the student should not think in terms of a subserous pedunculated fibroid which can be removed very simply, but rather of the case in which multiple fibroids are present and exercise the operator's judgment as to the best method of procedure so as to minimise trauma to the uterine wall, prevent dead spaces and leave, after healing, a sound cicatrix which will not cause anxiety should pregnancy occur subsequently. In point of fact, subsequent to myomectomy, rupture of the gravid uterus is an extremely rare occurrence (p. 598).

Where two tumours are close together it is a matter of judgment whether it is better to remove them separately or run the cavities together and close them as one cavity. In closing the bed of a tumour after enucleation the most important point is the avoidance of any dead space which will harbour blood and so increase the risk of infection and weaken the scar. If there is pronounced hypertrophy of the uterine musculature as a result of the presence of the tumours, it is unnecessary to take pains to remove this in an attempt to leave a uterus of normal size at the completion of the operation. If the tumours are removed the musculature will eventually shrink and the uterus be restored to normal shape and size.

Where a tumour is *submucous and pedunculated* it should if possible be removed through the cervical canal by the vaginal route. If of appreciable size and *sessile* the abdominal route will be necessary and,

even if large, enucleation without opening into the uterine cavity is generally possible. Should this occur, however, it is not of serious consequence. One has frequently been able to recognise the stage at which in removing a submucous fibroid the mucous membrane is all that separates the tumour from the uterine cavity. With a swab the membrane can be separated from the surface of the tumour, and when the tumour bed is obliterated it will be thrown into folds in the cavity. Like the hypertrophied myometrium it is unnecessary to remove this. It will correct itself ultimately.

For purposes of description a simple case is chosen—*e.g.* an interstitial fibromyoma of the posterior wall of the body of the uterus.

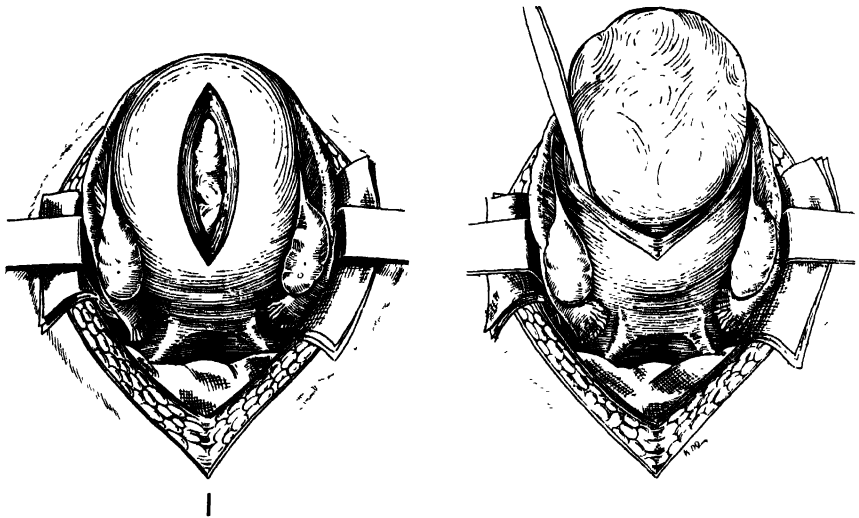


FIG. 465.—Myomectomy.

1. Incision of Capsule of Tumour.

2. Removal of Tumour.

An incision is made over the summit of the neoplasm through the covering tissues (Fig. 465 (1, 2)). With the fingers, or with the handle of the knife, the tumour is separated from its capsule, after which the uterine wound tends to close spontaneously by virtue of contraction of the muscle. The manipulation may be aided by traction on the tumour with volsellæ. The mistake most likely to be made by a novice is, to cut not deeply enough and to attempt to shell out the tumour before the whole thickness of the capsule has been incised. For suturing, different methods are practised, but usually mattress sutures are employed to close the cavity. The serous layer is united by fine catgut.

The operation is particularly suitable in young women, in whom conservation of the uterus for future pregnancy is so important.

Myomectomy for Broad Ligament Tumours.—An incision is made in the peritoneal covering and the tumour is enucleated by blunt

dissection. The cavity is closed by deep sutures and the peritoneum by a continuous superficial stitch.

There are, however, certain risks and possible dangers which necessitate special mention when myomectomy is employed for tumours occupying this site. When large, and especially if placed deep in the connective tissue of the pelvis, the removal of a broad ligament tumour with a wide attachment to the body of the uterus may be very difficult. In such a case the uterine vessels and ureter are often considerably displaced. In the case of the ureter this displacement is usually in a downward and outward direction.

When a fibromyoma arises from the side of the cervix, and bulges upwards between the layers of the broad ligament, it may carry the ureter upwards and place it in a position very liable to be injured unless the operator is alive to the possibility of its presence in this situation. After opening up the layers of the broad ligament, the lateral aspect of the tumour should be cleared easily by pushing down with a swab all tissues on the surface. A careful look out for ureter and uterine vessels should be kept, and if present the former must be preserved from injury while the latter are better ligated when freed from the surface of the growth.

A large broad ligament fibromyoma usually displaces the uterus in a lateral and upward direction, and is closely incorporated with the uterus. If the tumour has a wide attachment to the side of the uterus nothing short of hysterectomy is possible. If this is deemed the safer procedure then the method of hysterectomy described on p. 1115 and illustrated by Fig. 467 may be specially applicable.

ABDOMINAL HYSTERECTOMY

Indications.—Removal of the uterus may be required for disease of the uterus itself or for disease of the appendages or broad ligament.

- (a) *Uterine Disease.*—Hysterectomy is often necessary on account of the presence of a *tumour* or *tumours*—fibromyoma, adenomyoma, carcinoma, sarcoma, chorionepithelioma. It is sometimes required for *infection*—puerperal infection, chronic subinvolution (p. 926).
- (b) *Tubal or Ovarian Disease.*—*Tumours*—e.g. papillomatous cyst-adenoma and malignant tumours of ovary or tube (p. 1039). Some cases of *infection*—e.g. a bilateral pyosalpinx or salpingo-oöphoritis (p. 1036). Occasionally it is necessary in certain varieties of ectopic pregnancy (p. 344).
- (c) *Broad Ligament Tumours.*—Such tumours are sometimes so closely incorporated with the uterus that hysterectomy is required.

Varieties of Abdominal Hysterectomy.—These may be classified as follows : (1) Subtotal (supravaginal) hysterectomy : here the body of the uterus is removed at the level of the isthmus or between that level and the attachment of the vagina. This is the operation usually employed for fibromyoma when myomectomy is contraindicated. (2) Total hysterectomy : here the whole uterus, including the cervix, is removed. This is the operation employed in cases of cancer of the uterine body, chorionepithelioma, fibromyoma involving the cervix, and in any case in which there is associated an unhealthy condition of the cervix, such as severe laceration or chronic inflammatory hypertrophy. (3) Wertheim's hysterectomy for carcinoma of the cervix : here the whole uterus, tubes, ovaries, cellular tissue and lymphatic glands are removed.

(1) SUBTOTAL HYSTERECTOMY

The abdominal cavity having been opened, the operator investigates by hand and by sight the conditions present. If the patient is a young woman he must confirm first of all that hysterectomy is essential. It is a most serious procedure to remove the uterine body from a young woman if the whole or part of it can be conserved. In the case of fibromyomata this can be avoided by "myomectomy," so that it is seldom necessary to sacrifice the uterus. If the uterus cannot be conserved, either because of the nature of the disease or because of other conditions which clearly indicate that hysterectomy is necessary, and if the woman has not passed the menopause, he should endeavour to conserve the ovaries or at least a portion of healthy ovary. He must not, however, push conservatism beyond its rational limit.

The steps of the operation are as follows :-

The uterus is drawn up towards the wound and the surrounding organs packed off with large swabs.

The upper margin of the broad ligament on one side between the ovary and the uterus is seized with two clamp forceps and the tissue between them divided with scissors. If the tubes and ovaries have to be removed, the division is carried through the infundibulo-pelvic ligament. Fig. 466 illustrates the latter procedure on the left side only. The round ligament is divided between forceps close to the uterus. The same division of structures is carried out on the other side. The peritoneum is then divided across the front of the uterus at the reflection of the bladder, and this flap of peritoneum is pushed off the front of the cervix, carrying with it the bladder. The uterine vessels are now clamped close to the uterus and divided on the uterine side of the forceps, after which the uterus is amputated at the level of the isthmus or through the supravaginal cervix.

Occasionally it is an advantage to alter the order of procedure, and as is colloquially described, "work down the easy side and up the difficult side." This is perhaps specially applicable in cases of large

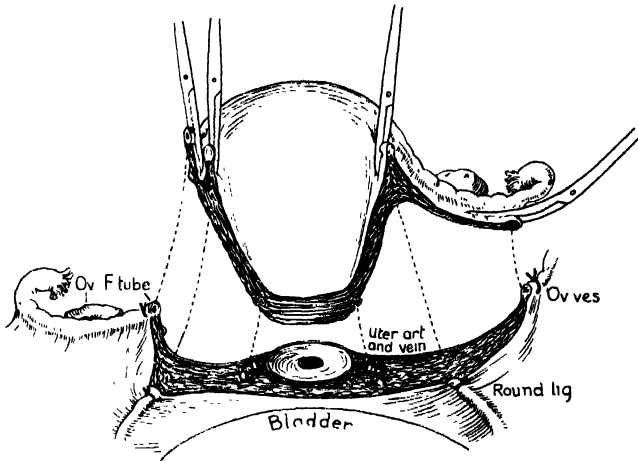


FIG. 466.—Subtotal or Supravaginal Hysterectomy with Conservation of Right Tube and Ovary (after Kelly).

fibromyomata situated in the broad ligament. In such cases the operator may find it better to begin on the healthy side of the pelvis. The ovarian vessels and round ligament are ligated and divided on the normal side, thereafter the ovarian vessels and round ligament on the side of the growth are similarly dealt with. An incision is now made across the peritoneum in front of the uterus and the growth, and the bladder and peritoneum are pushed downwards. The uterine vessels are then divided on the healthy side and the cervix is cut across, the uterine vessels being then seized on the diseased side (Fig. 467). The divided cervix

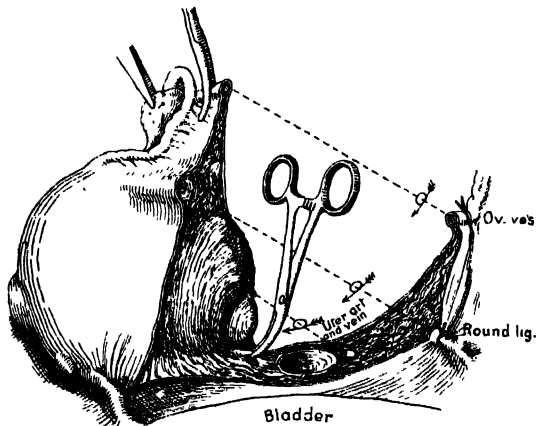


FIG. 467.—Subtotal Hysterectomy for Fibromyoma. Down one side and up the other as shown by arrows (after Kelly).

is pulled over toward the side of the tumour, and, by working with his fingers below the growth, the operator gradually frees it. During this part of the operation it is necessary that the surgeon "hugs" the growth closely, as otherwise the ureter may be damaged.

By this method the risk of damage to the ureter is greater than by a

painstaking downward dissection on the side of the tumour even if space is limited. The operator is returning the ureter to its normal situation and, as a rule, it is more easily identified. If, before dealing with the side on which the tumour lies, the attachments on the opposite side are divided, the tumour side becomes more accessible. If the method under consideration is adopted it should be remembered that on the tumour side there is a greater blood supply, often a bunch of large veins, readily torn if traction on the tumour mass is made. There is great temptation to do so to get access to clamp pedicles. When this happens the field of operation is obscured by bleeding and efforts to pick up the bleeding-points may result in clamping the ureter or other injury to it. There seems, therefore, to be little argument in favour of amputating the uterus through the cervix before all other attachments have been divided. To leave the cervical canal exposed while "going up the other side" leaves an area of potential infection. It should be exposed last and closed over first.

Many operators elect to "core" the cervix and remove the whole mucosa of the canal. The shell of cervix is then stitched. Apart from the advantage derived from removing the mucous membrane of the cervical canal and thereby eliminating a possible source of lodgment of infection and discharge from the cervical stump, by coring out the cervix more accurate approximation of the raw surfaces is possible.

At this stage of the operation a transverse gaping wound in the peritoneal lining of the pelvis remains. This is closed by means of a continuous catgut stitch which runs across from one side to the other and coapts the peritoneal flaps behind and in front. At either end of the wound the stump of broad ligament and round ligament are buried so that no raw surfaces are exposed (*vide* Fig. 424 (1, 2), p. 1065).

Any blood in the pelvic cavity is removed with swabs, a final examination made to see that there is no oozing, the large abdominal packing swabs removed, and the abdomen closed.

(2) TOTAL HYSTERECTOMY

The steps in this operation are as for subtotal hysterectomy up to the division of the uterine vessels, after which, procedure is as follows.

The utero-sacral ligament on each side is divided between clamp forceps, and the peritoneum is incised across the back of the uterus from one divided ligament to the other. A peritoneal flap is pushed off the back of the cervix and upper part of the vagina, and from this region of the vagina the rectum, if in contact, is separated.

In front the bladder is separated completely from the cervix and is stripped downwards off the upper part of the anterior vaginal wall. Here an opening is made into the vagina and the vaginal wall is

divided round the cervix, freeing the uterus finally from its attachments (Fig. 468).

A stitch is passed through the lateral extremities of the vaginal walls to control the vaginal vessels. This is the most likely source of troublesome bleeding.

After the clamp forceps have been replaced by ligatures and the vagina closed by sutures, the two peritoneal flaps are brought across to cover the pelvic floor, as in the subtotal operation. If the vaginal cervix is very unhealthy it is unwise to trust completely to preoperative

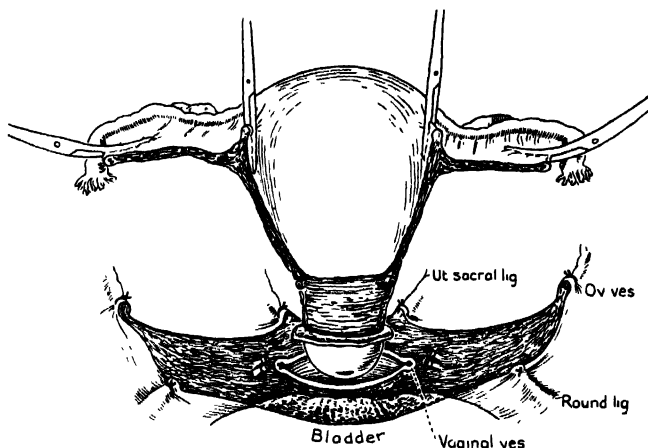


FIG. 468 —Total or Panhysterectomy (after Kelly).

cleansing. A length of gauze should be left (placed in contact with the raw surfaces, one end having been passed into the vagina) and the peritoneal flaps sutured over it (p. 1070). Provision is thus made for drainage from the retroperitoneal area, which is the area most liable to infection. The gauze is removed through the vagina after two or three days.

(3) TOTAL HYSTERECTOMY FOR CARCINOMA OF THE CERVIX (WERTHEIM'S OPERATION)

The advent of radium and deep X-rays for the treatment of cancer of the cervix (p. 972) has resulted in this operation now being performed but seldom in comparison with former times. It is, however, an operation which is instructive to the student, and one which may yet be decided to be the suitable method of treatment in selected cases of this disease. A brief description therefore is necessary.

The operation resembles total hysterectomy, the details of which have just been described. The operation of hysterectomy for cancer of the cervix, however, is a much more radical one. It aims at a wide

removal of the pelvic cellular tissue which extends from uterus to side wall of pelvis. The object of this is the removal of any malignant infiltration, which, as we have seen, is apt to occur along the lymphatics and the connective-tissue planes. It aims also at the extirpation of the pelvic glands. In addition, a cuff of the upper part of the vagina is removed clamped over the cancerous cervix. In this way the risk of the necrotic cancerous area sowing cancer cells and infection broadcast over the wound during manipulations is minimised.

Preparation.—To reduce the risks of infection and sometimes also the size of the growth, the cervix is curetted and cauterised. The vagina is then cleansed with iodine (2 per cent.) or violet green, as recommended by Carl Browning (p. 1057).

Technique.—The abdomen is opened in the usual way, a free incision being made. Instead of using volsellæ to pull up the uterus, it is safer (and likewise takes less room) to transfix the broad ligament (including the ovarian ligament, Fallopian tube and round ligament) at either uterine cornu with stout double linen or silk sutures, and use these ligatures held in forceps for traction purposes while manipulating the uterus during the course of the operation. The infundibulo-pelvic ligaments, containing the ovarian vessels, and the round ligaments are ligated and divided, and the peritoneal flap and bladder are pushed off the front of the cervix. The ureters are then located. To do this the posterior layer of the broad ligament is pulled upwards and the ureter is felt as it runs forwards by rolling it between the forefinger and thumb. It is traced forwards on either side to the point where it passes under the uterine artery (Fig. 20, p. 32).

By pushing the forefinger through the paracervical tissue above and along the course of the ureter this structure is freed from the uterine vessels, which are clamped, divided and ligated as close to the pelvic wall as possible. The ureter on either side is then freed right forward to the bladder. To prevent damage to the ureter during subsequent manipulations it may be held out of the way by an untied ligature passed round it and held with forceps.

The uterus is now pulled forwards and the peritoneal reflection along its back at the level of the pouch of Douglas is divided. The finger is pushed through the opening thus made and the rectum is separated from the posterior vaginal wall downwards for a distance of about $1\frac{1}{2}$ inches. The utero-sacral ligaments are divided and the mass of cellular tissue extending from cervix to pelvic wall is clamped with long forceps as near to the pelvic wall as possible, and divided with scissors, as much as possible of it being removed.

The bladder is gently pushed still farther off the anterior vaginal wall. The upper part of vagina is freed in front and behind, and now it should be possible to draw the uterus and vagina much farther upwards. The vagina is clamped across with the Wertheim rectangular

clamps as low as possible and well below the growth. It is then divided between the clamps. Ligatures are now applied to the vaginal stump, the clamped pedicles tied and all bleeding-points secured. The glands in the sacral hollow and along the common iliac vessels are dissected off as far as possible in one piece.

Before the peritoneal flaps are apposed to cover the raw pelvic surface all bleeding should have been arrested. Provision for drainage of the retroperitoneal area, as described for "total hysterectomy," is a matter of choice. There is more evidence in its favour than against it. The abdomen is closed in the usual way.

The dangers during the operation are: (1) injury to the *bladder* (this is especially liable to occur if the disease is burrowing close to the bladder: if the bladder is perforated by accident the perforation should be closed immediately); (2) injury to a *ureter*; (3) shock; (4) hæmorrhage. The postoperative dangers are: (1) shock; (2) sepsis; (3) hæmorrhage; (4) infection of the urinary tract: common, but need not necessarily be a serious complication.

VAGINAL HYSTERECTOMY

With the increasing favour given to abdominal hysterectomy the operation of removal of the uterus by the vaginal route has come to be less frequently performed in recent years. Few now employ it for cancer of the cervix as it does not give as good opportunities for extirpation of the surrounding connective tissue and glands as the abdominal route affords. Vaginal hysterectomy is still occasionally employed for fibromyomata of small size and for "fibrosis" uteri or chronic subinvolution. There is much less shock results from hysterectomy by the vaginal route than when the operation is carried out by the abdominal route. The method, if otherwise suitable, is specially applicable in stout elderly subjects in whom the abdominal operation is difficult, trying to the operator and has a risk slightly greater than the average. Interest in the operation has been revived by some, especially in America, who advocate its employment for procidentia (Mayo's Operation, p. 1104).

Technique.—The posterior vaginal wall being held back by a self-retaining speculum (Auvard's), the cervix is pulled down and closed by strong ligatures which are subsequently used for traction. In order to get freer access it is sometimes advisable to enlarge the vaginal outlet by para-vaginal section (Schuhardt's incision). This greatly facilitates the operation. The wound is, of course, repaired in the usual way after hysterectomy is completed.

The lower limit of the bladder having been noted, a circular incision is carried round the vaginal wall just below the bladder reflection. The bladder is now pushed off from the front of the cervix and

the utero-vesical pouch of peritoneum exposed (Fig. 469 (1)), and subsequently opened. The opening is widened with scissors. By stretching the opening thus made the uterus is detached in front. The next step is to free the cervix behind. By pulling the cervix downwards and forwards (Fig. 469 (2)) the peritoneum of the pouch of Douglas is exposed. An incision is then made into it and the opening enlarged with the fingers. This leaves the lateral attachments of the uterus to be dealt with.

The uterus is now pulled down firmly and drawn to one side. Guided by the index finger of the left hand a curved blunt needle is passed through the parametric tissue from before backwards above the level of the uterine vessels. By means of this needle a ligature is drawn back and tied round the uterine vessels at a little distance

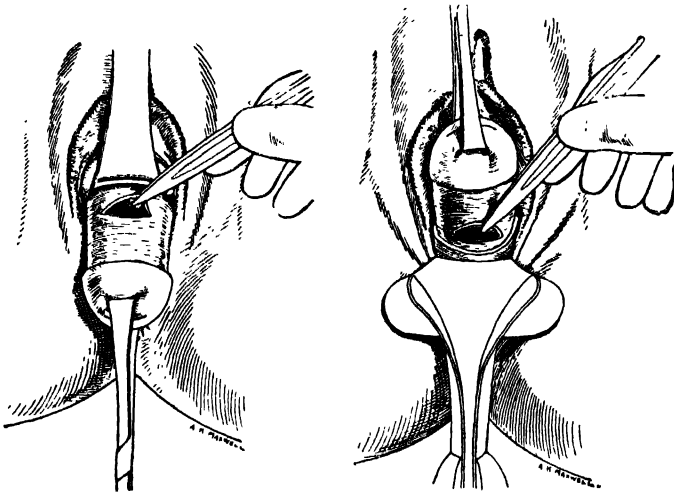


FIG. 469.—Vaginal Hysterectomy.

1. Bladder pushed up to give entrance to the Utero-vesical pouch.
2. Opening of the pouch of Douglas.

from the uterus (Fig. 470 (1)). With scissors the tissue is divided on the uterine side of the ligature. The uterine vessels on the other side are divided in the same way, after which the uterus can be drawn down a little farther. The broad ligaments are ligated on either side above this level and divided in the same way. Finally, the needle is passed over the upper margin of the broad ligament and the returned ligature when tied embraces the tube, round and ovarian ligaments with the ovarian vessels (Fig. 470 (2)). By this method the appendages are conserved and this is the simpler procedure. If there is reason to remove the tubes and ovaries, these are delivered in so far as is possible and the ligature cast lateral to them before removing them with the uterus.

An *alternative method* of performing vaginal hysterectomy consists in pulling the body of the uterus, by means of volsellæ through the opening made in the anterior cul-de-sac of peritoneum after the uterine vessels have been secured as described. In this way the womb is forcibly anteverted and the division of the broad ligaments is carried out from above downwards.

The *vaginal vault* may be left open or it may be closed partially by means of lateral sutures. In either case a fairly bulky gauze strip

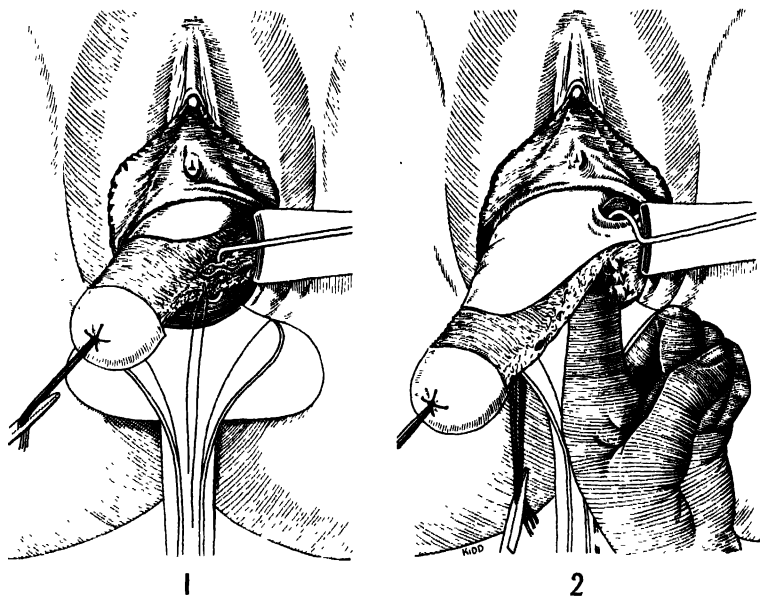


FIG. 470.—Vaginal Hysterectomy.

1. Ligating base of Broad Ligament and Uterine Vessels. 2. Ligating upper part of Broad Ligament, including round and ovarian ligaments with Ovarian Vessels.

should be passed into the pelvic cavity through the vaginal vault and should be removed, a small portion per day, over seven to ten days. Some operators prefer to close the vaginal vault completely without provision for drainage (Fig. 471).

The special *dangers* in vaginal hysterectomy are injury to bladder, ureter or small bowel, and hæmorrhage. Damage to bladder may occur from too forcible attempts at blunt dissection when the bladder is being pushed off the cervix. Injury to the ureter is avoided by making the division of the parametric tissue close to the uterus. The bowel may be damaged if a knuckle of small intestine escapes unnoticed through the vaginal vault and enters the vagina. To prevent this, a swab with a tape attached should be pushed into the peritoneal cavity when the utero-vesical pouch and the pouch of Douglas are opened.

Hæmorrhage is prevented by careful hæmostasis during the operation, every bleeding-point being grasped and ligated. Deep-seated bleeding

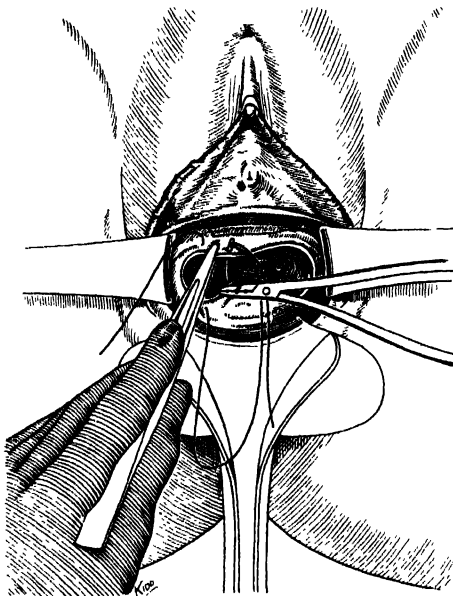


FIG. 471.—Vaginal Hysterectomy.
Closure of Vaginal Vault.

from the vaginal vault, where an encircling ligature cannot be placed, should be treated by a catch-forceps which may be left on the bleeding area for twenty-four hours. The handles are surrounded and supported in the vagina by a length of sterile gauze. This is seldom necessary.

Clamp Method.—The whole operation may be carried out by the “clamp method.” The utero-vesical and Douglas pouches are opened as already described. The broad ligaments on either side are clamped and divided by scissors on the uterine side. The uterus is then removed. Four clamps are usually sufficient. *By this means the uterus may be removed very*

rapidly. This may be of advantage if the patient is in very poor general condition. The clamps are surrounded with gauze packing; they are removed in thirty-six to forty-eight hours.

PLASTIC OPERATIONS ON UTERUS

Excluding operations on the cervix the only plastic operation upon the uterus practised extensively is myomectomy. Few malformations of the uterus lend themselves to conservative surgery. The conservation of the *normal cornu* in a Uterus Bicornis with a *rudimentary horn* has been mentioned (p. 360).

There have been a number of cases reported in which reconstruction of a Uterus Bicornis Symmetricus has been performed (Fig. 472). A V-shaped piece of tissue is removed from the two halves, which are then stitched together.

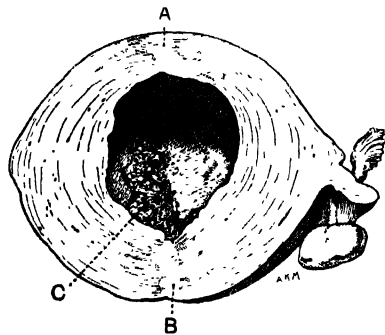


FIG. 472.—Reconstructed Uterus Bicornis Unicornis removed at subsequent (second) full-time pregnancy by Cesarean Section, followed by Hysterectomy. (Munro Kerr's Case.)

A and B. Cleavages on anterior and posterior walls. C. Placental site.

CHAPTER LVII

OPERATIONS ON THE OVARIES

Oöphorectomy—Ovarian Resection—Ovariectomy—Ovarian Grafting.

OÖPHORECTOMY AND RESECTION OF OVARY

OÖPHORECTOMY is the removal of an ovary. When the corresponding Fallopian tube is also removed the operation is called *salpingo-oöphorectomy*. If a portion only of the ovary is removed the operation is called *resection*. The indications for oöphorectomy have already been considered. The operation may be unilateral or bilateral.

The abdomen is opened in the usual way, with the patient in the Trendelenburg position, so as to keep the intestines as far as possible out of the pelvis, at the same time keeping them out of the way by one or two large gauze swabs suitably arranged, and with the aid of abdominal retractors, to allow a clear field of vision.

The fundus uteri is first located and the ovaries and tubes carefully explored. When there are no adhesions the affected ovary can usually be easily drawn up to the incision, and this should always be done where possible.

The infundibulo-pelvic ligament containing the ovarian artery is then clamped with pressure forceps, as is also the upper portion of the uterine end of the broad ligament containing the branches of the uterine artery, which anastomose with the ovarian vessels through the ovarian ligament. (If the Fallopian tube is to be removed at the same time, it is also included in the clamp.) The ovary is then cut away and a catgut ligature applied by transfixion replaces each clamp. The intervening portion of the broad ligament is brought together by a running stitch of fine catgut and the exposed ends of the stumps at each end of the broad ligament are turned in and covered by the peritoneum of the broad ligament.

If the tubes or ovaries contain pus the operation may be a very difficult one. In such cases the patient should be raised from the Trendelenburg position as a rule, and the pelvic cavity isolated by packing with gauze swabs to prevent possible contamination of the general peritoneal cavity. During the separation of adhesions it is frequently impossible to avoid the escape of pus, and the greatest care and patience are required for the necessary manipulations.

So far as possible adhesions should be separated under direct vision and not merely by the sense of touch. This is facilitated by the use of suitable abdominal retractors. In tuberculous cases specially great care must be exercised in avoiding injury to the intestine in case of subsequent fæcal fistula.

Resection of the Ovaries.—When dealing by operation with cystic ovaries or other non-suppurative lesions it may be desirable to conserve as much healthy ovarian tissue as possible, especially when the other ovary has been sacrificed. For example, especially in young and in nulliparous women, an attempt should be made to remove the diseased portion by a wedge-shaped incision; or the cyst, or possibly a fibroma, may be successfully shelled out. The raw surfaces so left are approximated by means of fine catgut sutures. The conservative

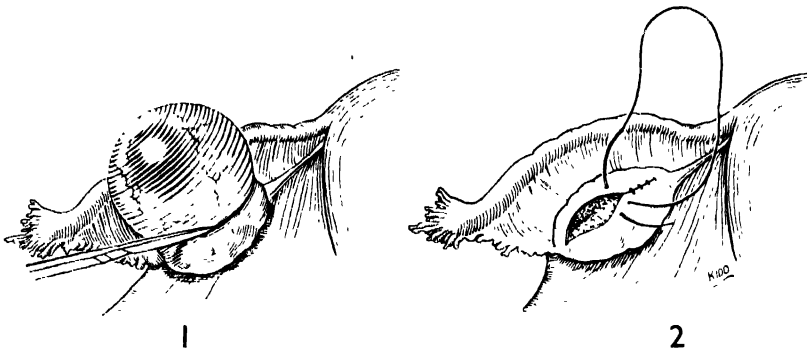


FIG 473.—Resection of the Ovaries.

1. Excision of Cyst. 2. Stitching Wound in Ovary

surgery of the ovary is not always permanently successful, as the development of cystic changes in the remaining portion is liable to occur and necessitate subsequent removal because of the recurrence of pain or menorrhagia. This risk, however, is well worth running in young women, as the writers have repeatedly met with cases where women, in whom only a relatively small portion of healthy ovarian tissue on one side had been left, have subsequently borne children. Apart from the possibility of pregnancy, menstruation continues unimpaired so long as a portion of healthy ovary is conserved.

OVARIOTOMY

Ovariectomy is the term applied to the operation for removing tumours of the ovary and broad ligament. It is usually done through an incision in the abdominal wall, though it may occasionally be done by the vaginal route. The classical abdominal operation will be described here.

After opening the peritoneal cavity the tumour should, if possible, be delivered through the incision without tapping it; the pedicle is secured and divided and the tumour removed. Tumours of small size

can be removed through a mesial or paramesial incision of from four to six inches in length, but with larger tumours a longer incision is, of course, necessary. After opening the abdomen and recognising the tumour the hand should be passed round it to ascertain whether it is adherent or not. If adhesions are present they must be liberated. If the adhesions are recent and mainly to the parietal peritoneum, they can be separated safely by the fingers, but adhesions to the omentum or intestine must always be dealt with by bringing them to the surface so that they may be seen in order to avoid troublesome bleeding or injury to the bowel. Any bleeding omental vessels must be ligatured, and if there is difficulty in separating adherent bowel from the tumour, a thin layer of cyst wall should be left attached to the bowel.

It is as a rule better not to tap an ovarian tumour before bringing it out through the incision. There is less risk in extending the incision above the umbilicus as far as necessary. The danger of tapping is the possible escape of the cyst contents into the peritoneal cavity and consequent infection. All ovarian tumours should be regarded as potentially malignant until proved otherwise. Moreover, many ovarian tumours have gelatinous contents which will not flow through a cannula, however large. If it is considered desirable to reduce a large cyst by tapping before removal, the greatest care must be taken to avoid any of the cyst contents escaping into the peritoneal cavity, by packing carefully all round with gauze swabs before introducing the trocar, and having a rubber tube attached to the cannula to carry away the fluid into a suitable receptacle below the table, or preferably a suction apparatus.

After the tumour has been delivered the pedicle is clamped with strong forceps just as in oöphorectomy, and the tumour is then cut away distally to the clamps (Fig. 474).

If the pedicle is very thin it may be tied *en masse*, but it is preferable to tie it in sections, securing the cardinal vessels—the ovarian artery in the infundibulo-pelvic fold and the anastomotic branch of the uterine artery in the ovarian ligament—close to the uterine cornu. These portions of the broad ligament should be transfixed with a pedicle needle and doubly tied with catgut, silk or linen thread. The intermediate portion of the broad ligament may then be closed with a running catgut stitch, care being taken to tie any bleeding-point in the broad ligament and to see that all raw surfaces are turned in and peritoneum sewn over to prevent the formation of subsequent adhesions. The other ovary and the appendix should be examined before closing the abdomen, and all gauze swabs, forceps, etc., must be carefully counted and checked.

The abdominal incision is then closed in layers—the peritoneum by a continuous catgut stitch; the two recti muscles by an appropriate number of stitches; the aponeurosis with mattress sutures of No. 4 catgut; the subcutaneous fat with a running stitch of fine catgut,

and the skin by Michel's clamps or suitable suture material. It is an advantage and conducive to greater safety to put in two or three deep supporting sutures of silkworm gut, including the aponeurosis, superficial fascia, and skin, which should be introduced after the peritoneum has been sutured but not tied till after the incision has been closed as described.

In dealing with primary or secondary broad ligament cysts, which, of course, have no pedicle, it will be necessary to incise the upper part

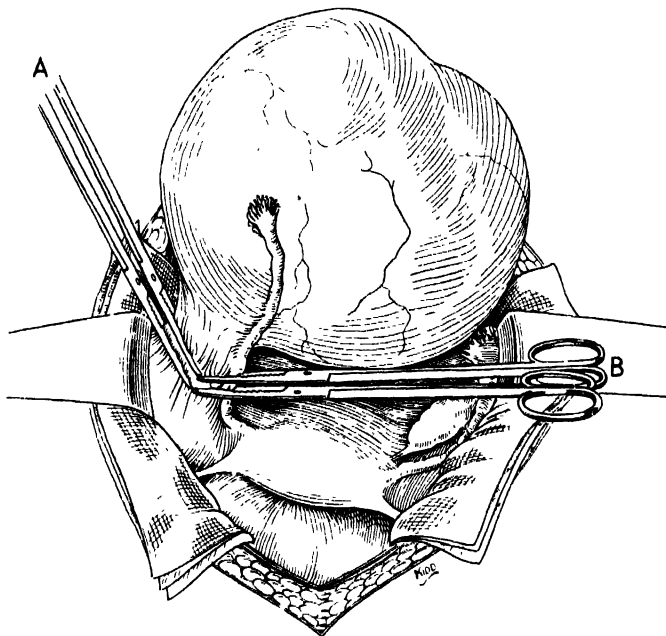


FIG. 474.—Clamping the Pedicle of an Ovarian Tumour (Right Side) in two portions before cutting. Tumour has been eventrated.

"A" clamps secure the Infundibulo-pelvic Ligament and "B" clamps grasp the uterine end of the Broad Ligament at the uterine cornu. Ligatures subsequently replace the proximal clamps.

of the broad ligament and thereafter enucleate the cyst from its bed. Before doing so the ovarian artery should be clamped and tied in the infundibulo-pelvic ligament and the anastomotic branch of the uterine artery at the uterine cornu similarly dealt with. Enucleation, then, is comparatively bloodless. If the tumour is small it is best to enucleate it intact by blunt dissection. If it is large it may be necessary to tap it first. Great care must be exercised not to tear the cyst wall and leave portions of it behind. *The danger of injuring the ureters in such cases must be kept in mind.* The bed of the tumour must be obliterated with catgut stitches applied from below upwards, and all bleeding-points must be carefully ligatured or understitched. The edges of the broad ligament are then brought together by a continuous catgut suture.

If the bed of the tumour be very vascular and the hæmorrhage cannot be controlled, or if the broad ligament cyst is infected, it may be necessary to pack the cavity with a long strip of sterile gauze or to drain the cavity with a rubber tube. Drainage may be carried out either through the vagina or suprapubically. Sometimes it is advisable to drain in both directions. When the vaginal route is chosen for drainage the broad ligament should, if possible, be closed from above so as to shut off the sac from the general peritoneal cavity.

HYSTERECTOMY COMBINED WITH OVARIOTOMY OR OÖPHORECTOMY

In cases of obvious or suspected malignant tumours the uterus and the other ovary should be removed as well.

Also in cases complicated by dense inflammatory adhesions, a combined hysterectomy sometimes simplifies the operation and facilitates the complete removal of the diseased structures. A combined hysterectomy may also simplify the control of hæmorrhage in some cases (see p. 1133, Salpingo-Oöphorectomy).

IRREMOVABLE OVARIAN CYSTS

Apart from inoperable malignant tumours, it is sometimes found that owing to dense and extensive adhesions it is impossible with safety to remove an ovarian cyst. In such cases the cyst and all secondary loculi should be evacuated, the cyst lining removed as far as possible and its edges stitched to the abdominal opening, and the cavity plugged with gauze. The abdomen must then be closed sufficiently to prevent herniation, an opening being left at the lower end of the wound for the removal of the gauze and subsequent drainage.

OVARIAN GRAFTING

Considerable experience has now accumulated on the question of grafting slices of healthy ovary into the tissues of a woman in the active period of sexual life from whom both ovaries have had to be removed. *Autotransplantation*, in which a slice of healthy tissue from the patient's own ovaries is used, naturally shows the best results, such as they are. There is little encouraging evidence as to *homotransplantation*, in which ovarian tissue from one woman is grafted into the tissues of another. *Heterotransplantation*, in which ovarian tissue from an animal of another species is used, has never proved successful in the human subject.

In all cases the graft, if it "takes," dies after a comparatively short time, say a year or two, but during that time it may sustain the menstrual function if the uterus has been left *in situ* and may

supply œstrin to an extent which converts an abrupt artificial menopause into a more natural and gradual one. The real value of the treatment is debatable, because there is so much variation in the effects of double oöphorectomy in different patients. At the best it is a palliative measure.

The technique of the method, briefly, is to place the removed ovaries in warm saline immediately after removal, and, after the peritoneum is closed, to cut one or two thin slices from the healthy portions. These are then placed in a dry position between the peritoneum and the rectus muscle or between the latter and the anterior rectus sheath. The closure of the abdomen is then completed. Two or three months elapse before the grafts can "take" sufficiently to function, and their life as a rule is brief. The advances of endocrinology in relation to the sex hormones, and the success of œstrogenic therapy in regard to menopausal symptoms, have led to an almost complete discontinuance of ovarian grafting

CHAPTER LVIII

OPERATIONS ON THE FALLOPIAN TUBES

Resection of Tube—Removal of Tubes—Removal of Tubes and Uterus

THE surgical treatment of the Fallopian tubes has passed from the extreme radical stage, which considered complete removal only, to the development of a more conservative technique.

It must be admitted, however, that in only a very small proportion of cases of tubal disease does conservative surgical treatment prove satisfactory. The principles underlying the surgical treatment of tubal disease have been discussed under the appropriate headings in Chapter LI.

CONSERVATIVE OPERATIONS ON THE FALLOPIAN TUBES

RESECTION OF THE FALLOPIAN TUBES (END-TO-END ANASTOMOSIS).—This operation may be performed where the pathological lesion is confined to a very small portion of the tube, as in cases associated with

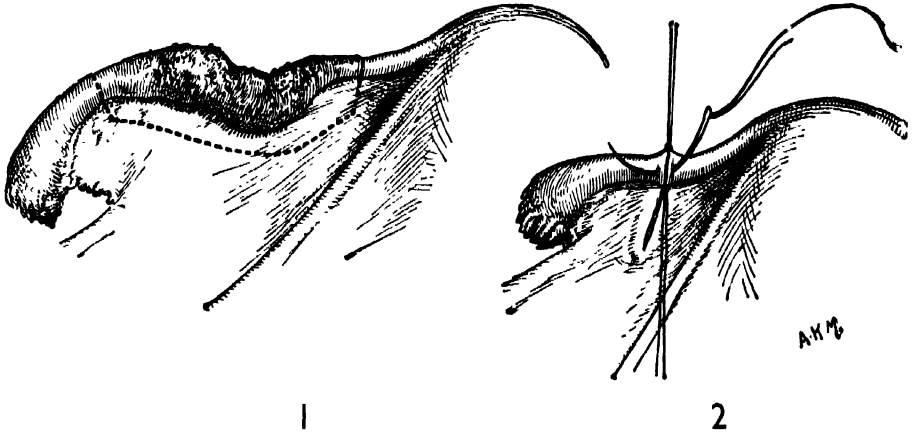


FIG. 475.—Resection of Tubes —The Right Fallopian Tubes injured by an Adherent Appendix.

1. Affected area in dotted lines.

2. End-to-end Anastomosis.

appendicitis. The diseased portion of the tube is excised and the ends united by three or four catgut sutures (Fig. 475).

FORMATION OF A NEW ABDOMINAL OSTIUM, OR SALPINGOSTOMY.—The closed end of the Fallopian tube is excised and the mucous membrane and the peritoneum coapted by a continuous suture (Fig. 476 (1)). The after-result of such an operation is shown in Fig. 476 (2). As an

alternative technique the end of the tube may be turned back and stitched to the peritoneal covering. This operation may be possible in cases of hydrosalpinx; cases of pyosalpinx are very seldom suitable.

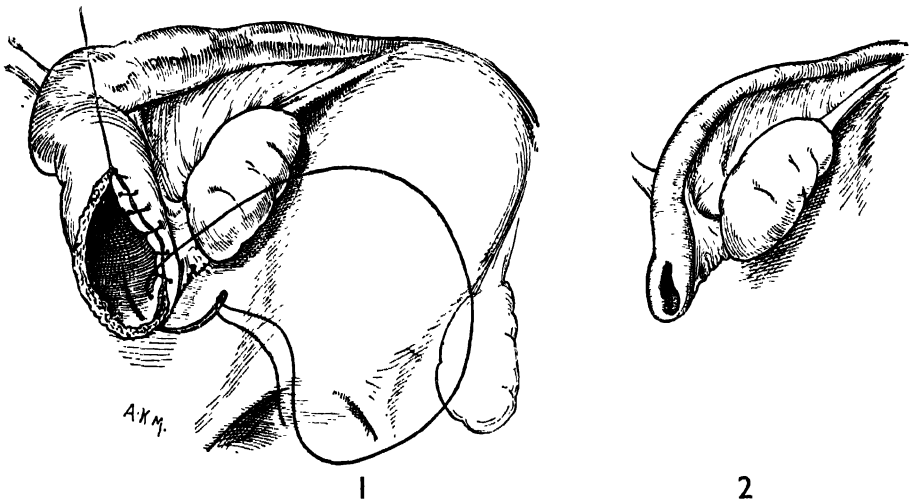


FIG. 476.—Salpingostomy—Formation of a new Abdominal Ostium.

1. Stitching Edges of Wound in Tube.

2. Appearance of opening later.

CONSERVATIVE TREATMENT OF THE TUBES IN ECTOPIC PREGNANCY.—Where the ovum is implanted in the outer portion of the tube it may be possible to enucleate the ovum from its bed by the finger, as in a case of intrauterine abortion. If there is no free hæmorrhage from the tube after this removal the tube may be left *in situ* (*vide* p. 358); but the procedure is only safe if there is practically no oozing. In very exceptional cases it may be possible to resect the tube, as has been already described—for example, this might be possible in the case illustrated (Fig. 476).

SALPINGECTOMY—REMOVAL OF THE TUBES

CASES OF ECTOPIC PREGNANCY.—In most cases of ectopic pregnancy the whole tube has to be sacrificed. The mesosalpinx and the uterine end of the tube are tied in either a figure-of-eight or two separate ligatures—the ovary is conserved wherever possible as here shown (Fig. 477).

CASES OF INFLAMMATORY LESIONS OF THE TUBES.—In chronic inflammatory lesions of the tubes there may be such a degree of dense matting of the pelvic viscera that the removal of the diseased organs may be extremely difficult. Where both tubes have to be sacrificed it is better to remove the uterus as well, for by doing so one not only removes the infected uterus, but also secures a more uniformly smooth pelvic floor. A portion of the ovary may be conserved. Where the ovary cannot be conserved *in situ*, a portion

of ovarian tissue may be implanted in the remains of one broad ligament or in the cellular tissue of the lateral wall of the pelvis.

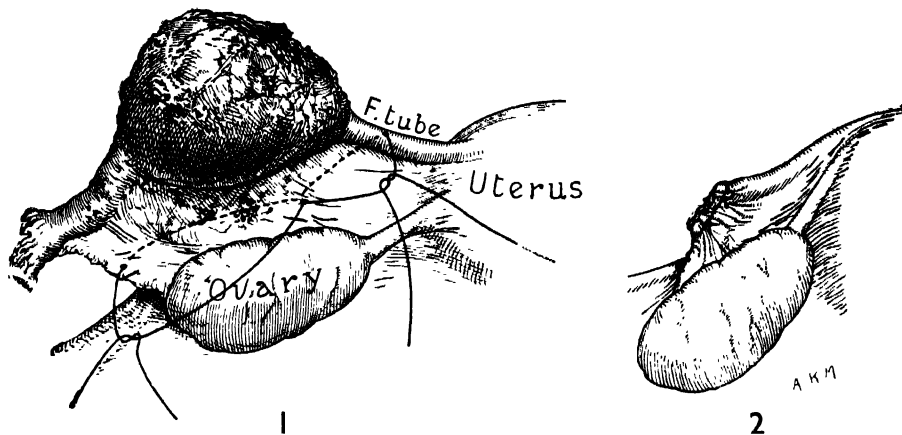


FIG. 477.—Removal of Tube for a Tubal Pregnancy with conservation of Ovary.
It may be possible in a case such as this to ressect the tube (*vide* Fig. 475).

1. Method of Removal.

2. Stump after Removal.

With the means now available to combat an acute menopause conservation of ovarian tissue is not deemed so necessary as formerly.

SIMPLE SALPINGECTOMY.—This operation is suitable for those cases in which the tube can be easily isolated. The mesosalpinx and the

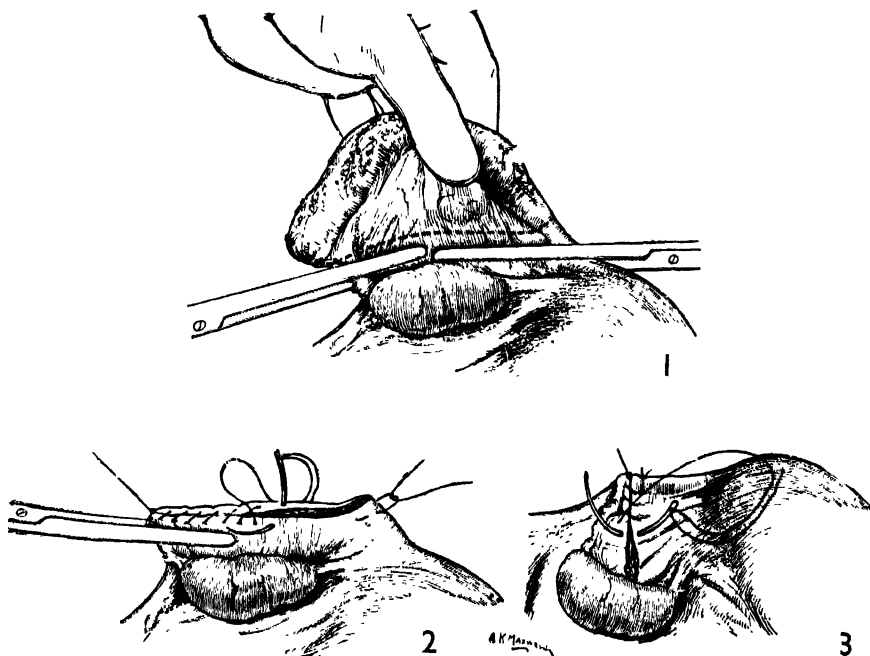


FIG. 478.—Simple Salpingectomy where the Ovary can be Conserved.

1, 2, 3. Stages in Operation described in text.

uterine end of the tube are clamped (Fig. 478 (1)). When the tube has been excised the raw surfaces may be dealt with either by running a continuous fine catgut suture along the raw edges (Fig. 478 (2)), or by doubling over the tissue and stitching the free end of the tube to the stump of the infundibulo-pelvic ligament (Fig. 478 (3)). In many cases the tube is too adherent to allow this simple procedure to be carried out.

MORE COMPLICATED PROCEDURES.—In more complicated cases the greatest care must be exercised in separating the adherent tubes lest the bowel be injured. Where possible the adhesions should be broken down with the finger and thumb; where they are more dense, the

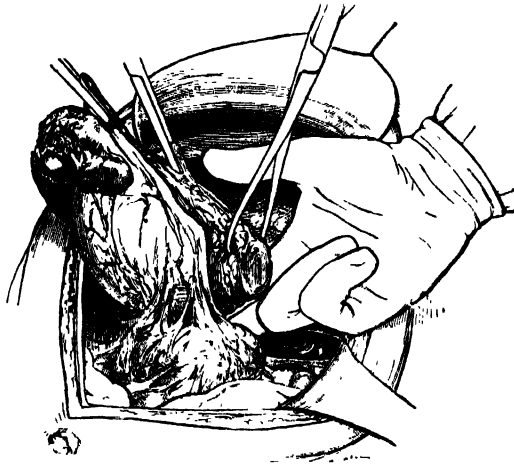


Fig. 479.—Method down easy and up difficult side. This procedure is similar to that employed in certain cases of hysterectomy for fibromyomata (Fig. 467, p. 1115).

tubes may have to be separated from the bowel by sponging with gauze or by very careful snipping with scissors.

In cases of this nature it may be, as already stated, advisable to remove the uterus with the tubes. When the tubes and ovaries have been freed the simplest method is to carry out practically the same technique as that employed for complete removal of the uterus for fibromyomata (p. 1116). As the distended tubes may get in the way it may be advisable to remove them and so secure better access to the region of the cervix. Because this preliminary separation of the tubes and ovaries may prove so difficult, various modifications in technique have been devised.

In cases where one side is more affected than the other a very useful variation is to go down the less affected side and up the more difficult side (Fig. 479). This allows the second tube to be stripped out of its bed from below. The round ligament, the infundibulo-pelvic ligament and the uterine vessels are clamped on the less affected side

and the tissues divided. The cervix is cut across ; then arrives the most difficult step in the operation—namely, the securing of the uterine vessels on the more affected side from below. Too extensive a grip of the paracervical tissue may cause the ureter to be caught in the clamp. When the uterus has been freed in this way the operator burrows his fingers under the second tube and separates it from its bed (Fig. 479). Finally, the infundibulo-pelvic and round ligaments are clamped and tied off.

Where both sides are equally and very extensively affected the easier way may be to remove the uterus first and then deal with each

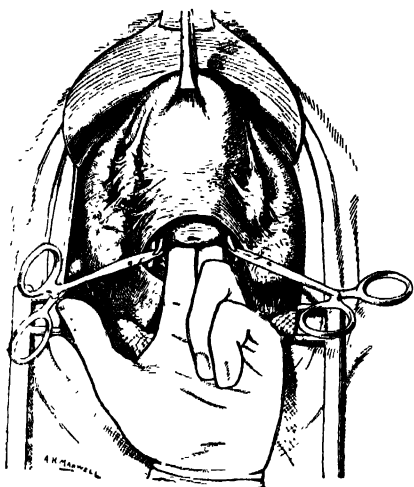


FIG. 480.—Posterior Decollation.
(Faure's Method)

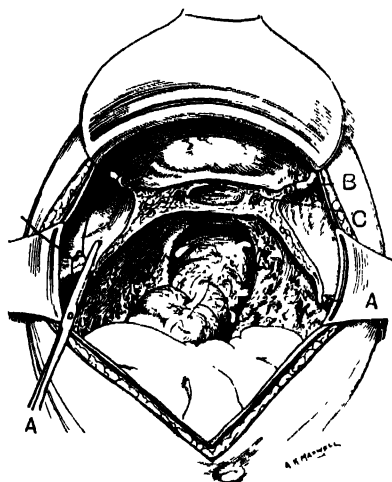


FIG. 481.—Ligation of Different Vessels
which are referred to in text below.

tube from below upwards. Another modification suitable for this type of case is to bisect the uterus in the sagittal plane ; then, having cut across each half of cervix transversely and secured the uterine vessels, to work from the cervix upwards and outwards on each side. In cutting outwards through the cervix great care must be taken to avoid injury to the ureters.

Another variation is the operation of “posterior decollation,” where the fundus is pulled up and the cervix cut across (Fig. 480). The uterine vessels are picked up and then the operator, by his fingers, gradually dissects out each matted tube. A more difficult operation of the same type is “anterior decollation,” where the cervix is incised from behind.

In the operations described the uterus has been removed by supravaginal amputation. It is more satisfactory to complete the operation by removing the stump of the cervix or by “coring” the cervix, as the mucous membrane may still act as an infective focus and be the site for a carcinoma to develop later.

In all these operations very great attention should be given to the eventual covering of the pelvic floor with peritoneum. Complete hæmostasis should be secured before this is done. Fig. 481 shows the

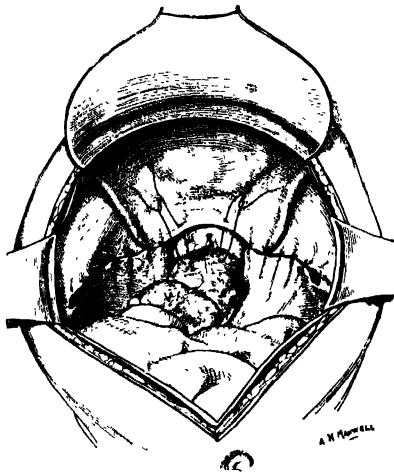


FIG. 482.- Covering Pelvic Floor with Peritoneum.

pelvic floor after the uterus and adnexa have been removed. On one side the clamp A is attached to the infundibulo-pelvic ligament; on the other side A marks the same ligament when it has been tied off. B shows the tied round ligament. C shows the secured uterine vessels. The roughened surface of the peritoneum is seen on the pelvic wall and on the anterior surface of the rectum.

Fig. 482 shows the methods adopted to cover the floor with peritoneum. There may be considerable tension on the flaps of the peritoneum. The more completely the pelvic floor is covered with peritoneum the better.

It is apparent that operations for pyosalpinx and other infectious conditions of the pelvis may be most difficult. They call for great surgical experience and technical skill on the part of the operator. Obviously, in a text-book written primarily for students, all that is called for is to indicate the various surgical procedures employed, as has been done.

PART XII
RADIOLOGY

CHAPTER LIX

RADIOGRAPHY—RADIUM AND X-RAY THERAPY

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RADIOGRAPHY

THE progress of radiography has been rapid and extensive in practically every branch of medicine ; yet it appears to have lagged behind in the department of obstetrics and gynaecology.

This has been, no doubt, partly due to the fears expressed by the early workers in X-ray that damage might be done to the foetus. Such fears were not groundless when one considers the type of apparatus that was available in those days, and the injuries that resulted from radiography in consequence of lack of knowledge of the properties of X-rays.

In the Department of the Glasgow Royal Maternity Hospital so far there has been no indication that injury has been done to any mother or child. With present-day methods the possibility of injury can be ruled out.

It is only within recent years that the use of X-rays in obstetrics has become general, and even to-day it is not fully appreciated how much exact information, with particular regard to certain conditions, it is possible to attain. Radiography has become essential to the obstetrician and gynaecologist. It should, however, in no way replace the usual clinical methods of examination, but rather supplement them. Most cases can be, and are, diagnosed by the clinician, but there remain a number in which exact diagnosis is only possible by radiography. In obstetrics and gynaecology as in every other branch of medicine close co-operation between the clinician and the radiologist is essential if the maximum degree of exactness in diagnosis is to be secured.

Radiographic investigation should be available for every doubtful case, and an up-to-date maternity hospital is incomplete without an efficient X-ray department.

Before the radiological department was established in the Glasgow Royal Maternity Hospital it was found inconvenient, and in many instances impossible owing to the patient's condition, to transport her to another institution for the purpose of a radiographic examination. In the Glasgow Royal Maternity Hospital the X-ray department is in close proximity to the labour rooms so that if difficulties arise during labour an X-ray examination can easily be carried out, without unduly disturbing the patient, if this is deemed advisable.

Films of the very finest quality, showing maximum detail, are essential and these must be taken in the shortest possible time to avoid movement, especially of the foetus. An actively moving foetus can so blur itself out that it will not be seen on the film, but this is exceptional if the exposure time is reduced to one second. This speed has been

achieved by the use of high-powered apparatus, Potter-Bucky diaphragm, rapid films, double intensifying screens, and the great detail obtained by the very small focal spot in the present day X-ray tube. Longer exposures may be used when the part can be immobilised or where a greater tube-film distance is necessary to prevent distortion; but other factors, kilovoltage (penetration), milliamperage (quantity), must be varied accordingly so that the patient receives approximately the same amount of radiation.

The closer the object is to the film and the greater the distance from the tube, the nearer to the actual size will be the object on the film. As great a tube-film distance as possible is therefore advisable; but this is



FIG. 483.—Pelvimetry—Patient Sitting. In this position plane of pelvic brim is horizontal.

limited by the output of the tube and the fact that the exposure time varies, not with the distance but according to the square of the distance. In actual practice a distance of 36 inches has been found most useful.

The position of the patient varies with the part to be examined. The contents of the pelvis can be conveniently filmed with the patient in the *dorsal* decubitus. If, however, the gravid uterus has left the pelvis, the *prone* position will bring the uterus closer to the film and will prevent distortion. There is no inconvenience to the patient in assuming this position provided she is suitably supported by pillows below the chest and thighs. The abdomen becomes suspended between the pillows without undue pressure being exerted on the anterior abdominal wall. Lateral films may be taken with the patient lying on the film or, preferably, standing against the film, which is placed vertically.

The apparatus used in the X-ray department of the Glasgow Royal Maternity Hospital consists of a four-valve machine with an output of 350 milliamperes at 100 kilovolts. All films can easily be taken within this rating. The Bucky table is made to tilt so that the patient can be placed at any particular angle. There is no great advantage in this type of table in obstetrics and gynæcology, but in any large maternity hospital a considerable amount of ordinary radiography has to be undertaken, such as barium meals or enemas,

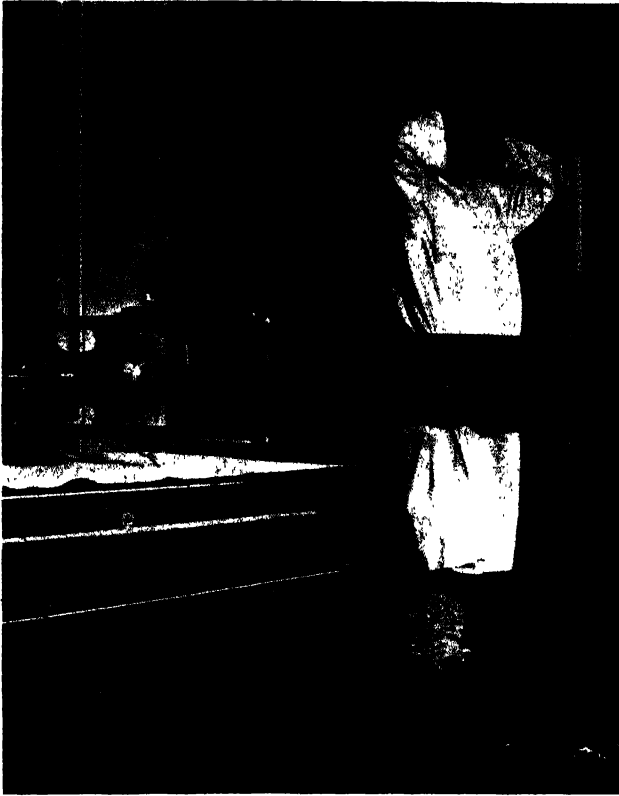


FIG. 484.—Pelvimetry—Patient Standing for Lateral View.

and for these the tilting table provides a great advantage. The tube stand which runs alongside the table is specially high in order that films can be conveniently taken at 5 feet distance. A vertical film carrier is used for the lateral view of pelvis with the patient standing against it, and also for chest radiography of which there is a considerable amount.

I propose in the first instance to summarise very briefly the various conditions which can be determined by radiography, and later to describe the technique for radiographic pelvimetry and cephalometry, and finally, the technique employed for investigating other gynæcological conditions not connected with pregnancy.



FIG. 485.—Early Pregnancy.

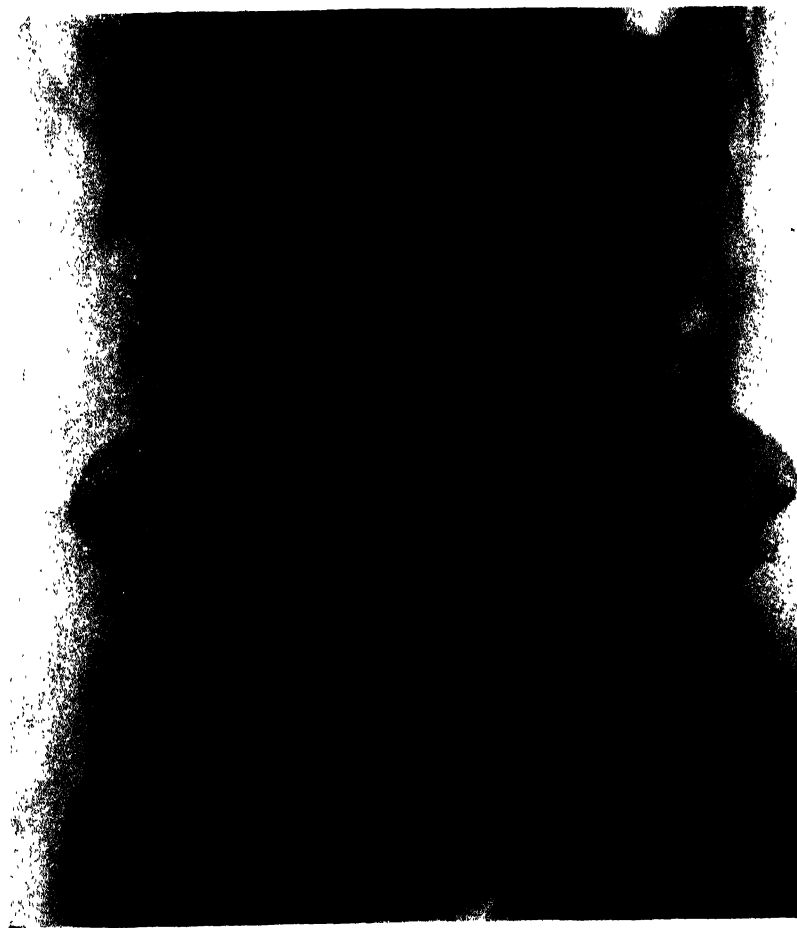


FIG. 486 —Intrauterine Death (Spalding's Sign).

DIAGNOSIS OF PREGNANCY

In the case of early pregnancy first-class films showing maximum contrast are essential. They must be taken in the shortest possible time to avoid movement.

A diagnosis can usually be made from sixteen weeks onwards. The earliest period in the writer's experience has been fifteen weeks, but others have reported an earlier date.

The Aschheim-Zondek and Friedman tests give reliable information regarding early pregnancy before there could be any sign on an X-ray film, and most obstetricians prefer this method of diagnosis in the early weeks. Later in pregnancy the radiographic method may be more convenient, as by employing it an immediate and definite diagnosis is possible.

INTRAUTERINE DEATH

In this condition the sign looked for is that described by Spalding—viz., overlap of cranial bones (Spalding's Sign). It may appear in from twelve to twenty-four hours after the death of the foetus.

If the condition is suspected, but not confirmed radiographically, the X-ray examination should be repeated at intervals, and if overlap does not occur and growth takes place the foetus must be alive. In addition to the overlap of the cranial bones the whole trunk becomes crumpled up, and if maceration exists to any extent there may be great confusion regarding the distribution of head, trunk and limbs.

When the head has become moulded during labour, overlap of cranial bones does not indicate death of foetus—it is a natural process. This has to be remembered when a radiograph is taken during labour.



FIG. 488.—Breech with Extended Legs.



FIG. 487.—Shoulder Presentation (Transverse "lie").

PRESENTATION

Two films, postero-anterior and lateral views, are usually sufficient to answer this question. The presenting part can be determined and the position of the head, spine and limbs seen, and any undue flexion, extension or torsion of head noted. Torsion of head varies greatly.

In vertex presentations the postero-anterior view shows to which side the occiput, back and limbs are directed. In the lateral view, the forward or backward position of the spine indicates the diameter into which the head is entering, provided there is not an undue degree of torsion of head. Face and brow presentations can also be recognised and the position of the chin determined. If the foetus lies obliquely, or a shoulder presents, the position of the head, back and limbs can be determined, as shown in radiograph opposite.

In the case of breech presentation the disposition of the limbs should be noted (p. 459). If prophylactic version (p. 464) is performed, it may be advisable to have an X-ray examination later as changes in presentation, position and attitude may take place till well on in labour.

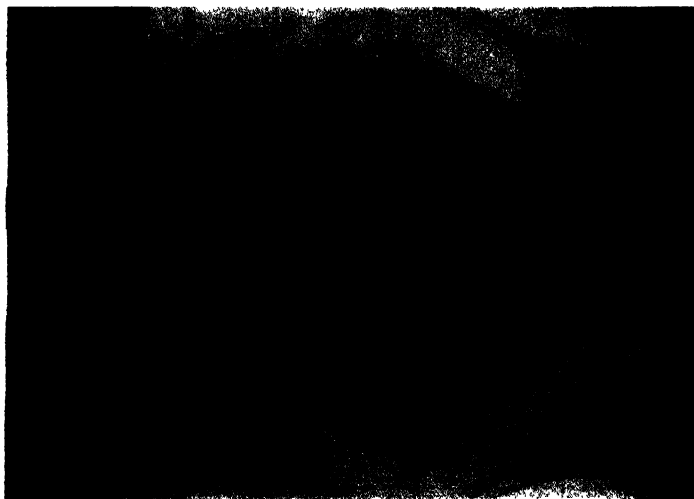


FIG. 490.—Twins

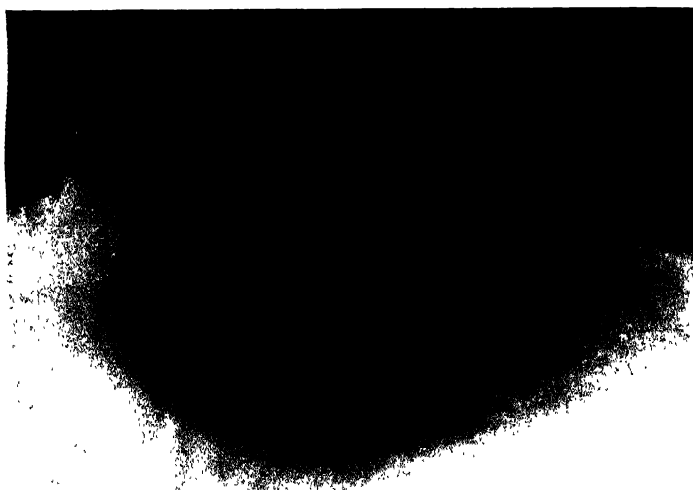


FIG. 489.—Triplets.

PLURAL PREGNANCY AND FŒTAL ABNORMALITIES

Although in most cases plural pregnancy can be diagnosed by ordinary clinical methods there is a considerable number of cases in which this is not possible except by radiography. Furthermore, if multiple pregnancy exists the relative position of the foetuses may be noted and this information may be of value to the obstetrician in his conduct of the case. The same applies if the film shows foetal abnormalities which are not uncommon in plural pregnancy, more especially with uniovular twins. Some of these abnormalities are shown on the two following pages.

The recognition of pronounced foetal deformities in pregnancy may be extremely important because it may justify the induction of labour and the emptying of the uterus of useless contents. They are usually found by chance during or after delivery, *but should always be suspected if hydramnios exists to any extent*. Radiography during pregnancy is generally the only means of determining the true state of affairs.

FŒTAL ABNORMALITIES

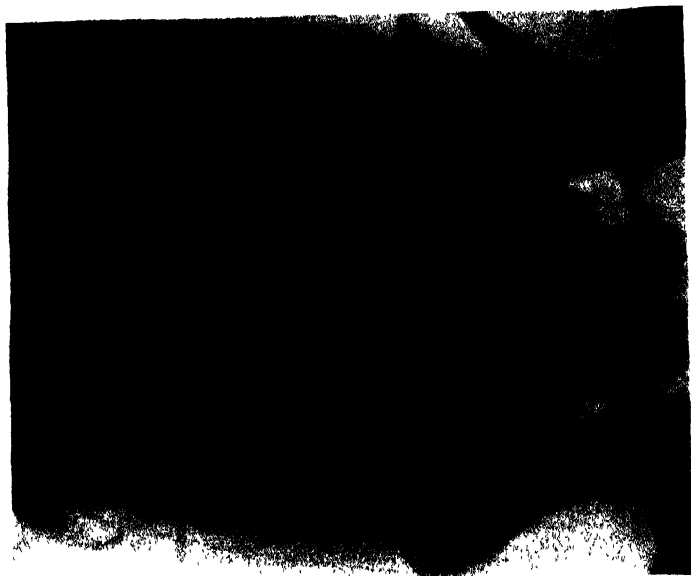


FIG. 492.—Hydrocephalus.

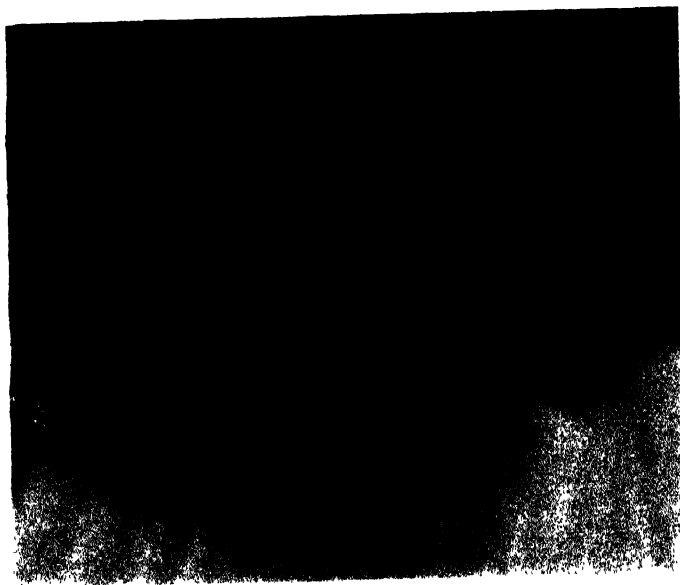


FIG. 491.—Anencephalic Monster.

FŒTAL ABNORMALITIES

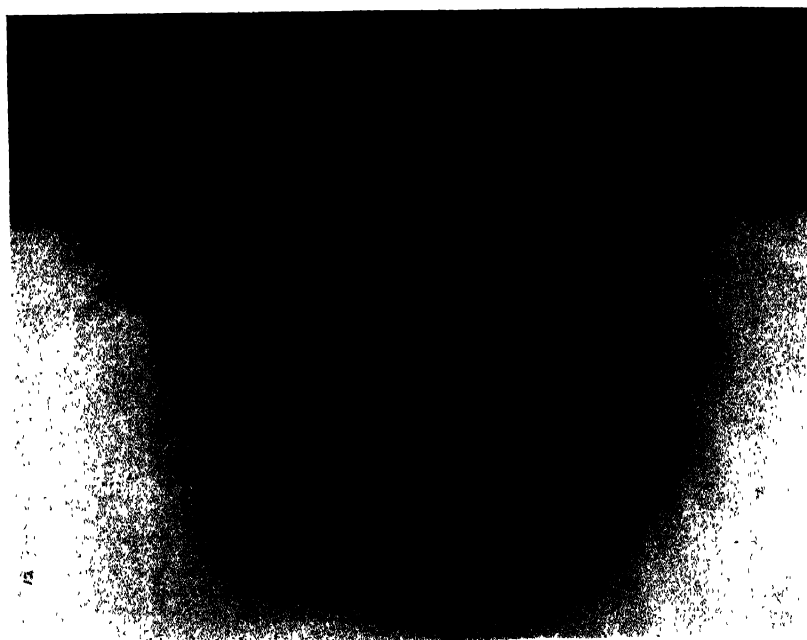


FIG. 493.—Fœtal Dropsy.



FIG. 494.—Multiple Deformities.



FIG. 495.—Postero-anterior Radiograph. The defect produced by the placenta (x, x) is seen in the left side of the fundus of the uterus. The head is engaging in the brim of the pelvis. Accidental hæmorrhage.

Uroselectan B (20 c.c.), innocuous to mother or child, is injected into the amniotic sac through the abdominal wall. The substance mixes with the liquor amnii and makes it opaque to X-rays, so that a complete outline of the uterus is obtained. The outline of child is naturally obscure. From good radiograms it is possible to determine the position of the placenta. A defect or flattening in shadow of outline of uterus

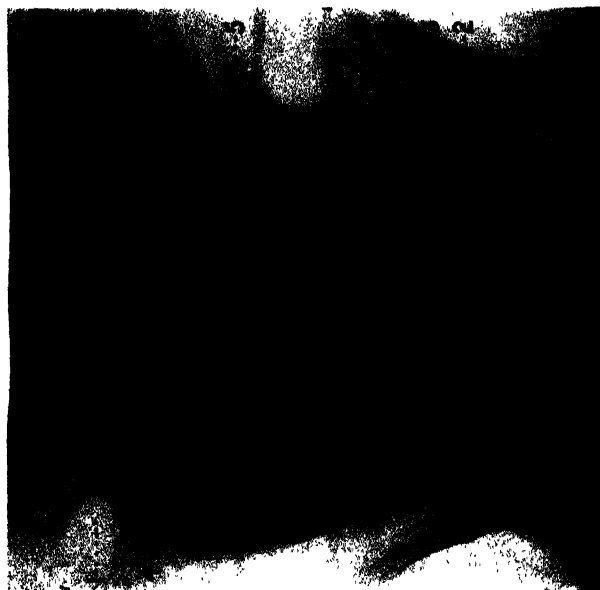


FIG. 496.—Postero-anterior Radiograph. A defect caused by a part of the placenta is seen in the fundus (x, x). The appearances due to gas in overlapping bowel (1) and pressure against the wall of the uterus (2) are illustrated. The umbilical cord is encircling the neck (3). The serotum (4) and shadow of the stomach (5) are visible but faint.

of the stomach (5) are visible but faint. The substance mixes with the liquor amnii and makes it opaque to X-rays, so that a complete outline of the uterus is obtained. The outline of child is naturally obscure. From good radiograms it is possible to determine the position of the placenta. A defect or flattening in shadow of outline of uterus

PLACENTA PRÆVIA

The position of the placenta is sometimes observed on a straight film, but this is unusual in the writer's experience.

Indirect methods of locating the placenta consist of the injection of opaque substances into : (a) the amniotic cavity—amniography ; (b) into the bladder—cystography.

(a) *Amniography*.—The idea underlying this method is the production of an opacity in the amniotic fluid so causing the placental site to stand out as a "filling defect." Some 20 c.c. amniotic fluid is withdrawn by trocar and cannula passed through the abdominal wall into the amniotic sac. The site of aspiration is carefully chosen. An equal amount of the solution selected is injected to take the place of the amniotic fluid removed. The patient is then advised to move about in bed in order that the solution may become well mixed with the liquor amnii.

Munro Kerr and Mackay, employing uroselectan B., reported a series of cases in which good pictures of the placental site were obtained without any injury to the foetus. In nearly 50 per cent. of these cases, however, premature labour followed. Perambrodil has been employed in University College Hospital (Prof. J. F. Browne) with success in some instances. With the use of this drug the incidence of premature labour is lower than is the case with uroselectan B.

The writer feels that the above method has great possibilities if a solution for injecting into the amniotic cavity can be discovered which has no tendency to induce labour.

(b) *Cystography*.—This method was described by Ude, Weum and Winer. The bladder is emptied by catheter and about two ounces of a 12½ per cent. sodium-iodide solution are run into it. If the placenta covers the os there will be a separation between the foetal head shadow and the shadow of fundus of the bladder. This procedure is only of use, therefore, in vertex presentations with the head low down in the pelvis. Care must be taken not to overfill the bladder, otherwise the enlarged concave surface of the bladder may be so deep that separation due to placenta prævia or blood clot from accidental hæmorrhage may not be apparent. The method is by no means infallible and has not been a great success in the hands of the writer. It is, however, a simple and harmless procedure, and it may well be carried out in any doubtful cases on the chance of obtaining information regarding this serious and dangerous complication.

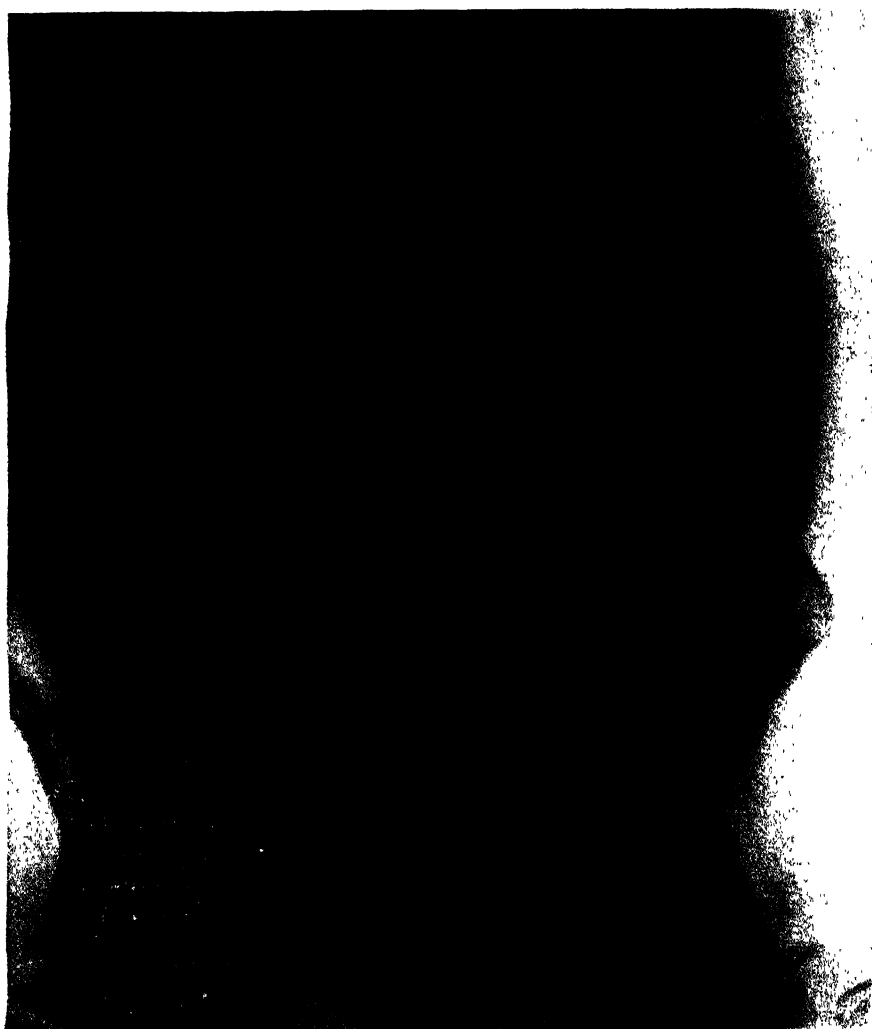


FIG. 497.—Mature Fœtus

AGE, SIZE, MATURITY AND POST-MATURITY

The writer makes no claim to be able by radiography to furnish the obstetrician with very exact information regarding these matters. As a general rule the age of the foetus can be determined by ordinary clinical methods. On occasions radiography may be of assistance. The two facts to be investigated are : (a) the size of the foetus, and (b) the stage of ossification of individual bones.

Regarding the size of the foetus it is not possible to show on a film the exact proportions, as the parts farthest away from the film will be relatively large compared to the parts which are close up. The general appearance on a film is, therefore, not an exact guide ; although an expression of opinion by one who has examined many films may be of value. If the foetal head can be easily located an estimate of the diameters may be informative ; but, as the weight of a newborn child can vary within wide limits, the size of the head may not be a very accurate indication of weight and size of child.

Regarding the stage of ossification of bones there is a fairly wide variation in their appearance, sometimes as much as three to four weeks. According to various authorities the average dates at which the following centres can be recognised are :—

Os calcis	12 to 16 weeks.
Astragalus	24 to 32 „
Cuboid	40 „
Lower end femur	35 to 40 „
Upper epiphysis of tibia	40 „

The presence or absence of these centres in conjunction with other data may be of value.

Post-maturity is suggested by the size of the foetus and the presence of the various centres mentioned above, especially the cuboid and upper epiphysis of tibia which appear from thirty-fifth to fortieth week.

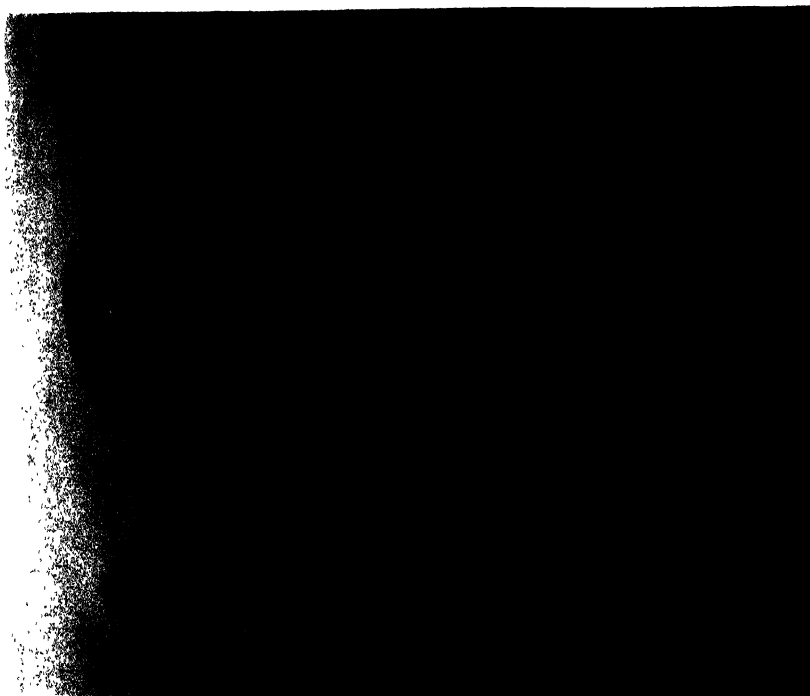


FIG. 498.- Extrauterine Pregnancy

ECTOPIC PREGNANCY

Ectopic pregnancy usually manifests itself and is diagnosed by clinical methods in its early stages, before foetal parts can be demonstrated by radiography.

If, however, the condition exists and pregnancy continues till the foetus can be clearly seen by X-rays, it may be located in an unusual position—possibly high in the abdominal cavity or low in the pelvis. Cases have been reported in which the suspicion of an advanced ectopic pregnancy has been confirmed by passing a sound into the uterus or, alternatively, injecting the uterus with lipiodol and noting the relationship of the foetus to the shadow presented by sound or lipiodol. The presence of a double uterus must be kept in mind in these circumstances.

On occasions an old ectopic pregnancy sac (lithopedion) has been revealed in a radiograph taken for some other purpose.

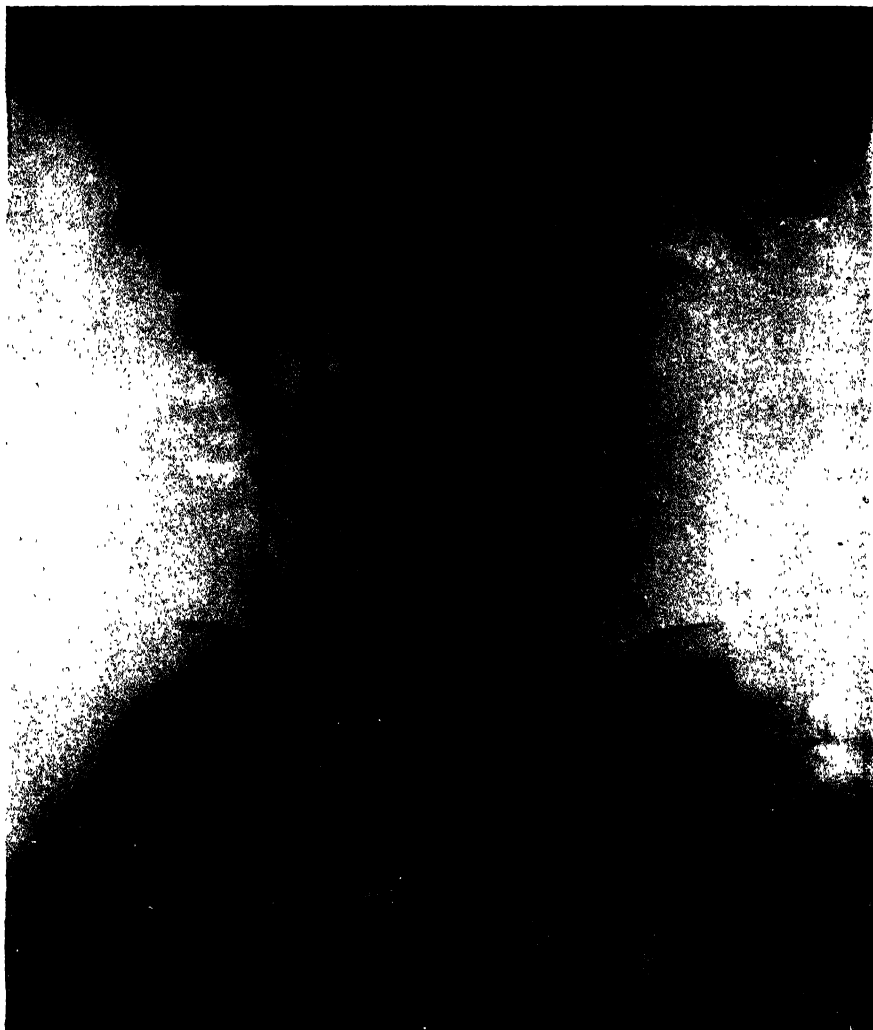


FIG. 499.—Healthy Primigravida Four Months Pregnant. Urine Sterile. Showing physiological dilatation of right urinary tract (ureter, pelvis of kidney and calyces) and kinking of ureter.

PYELOGRAPHY

The subject is discussed in considerable detail in Chapter XII, p. 262.

Uroselectan is given intravenously, and in normal functioning kidneys a good shadow of the kidney cavities can be obtained in a few minutes. If, however, renal function is defective there may be delay. In the large majority of pregnant women dilatation of the urinary tract takes place. The right side is usually more affected than the left. "Kinking" of the ureters may take place, but this is usually more marked on the right side. Again, dilatation is more marked in primigravidæ than in multigravidæ. It may be found as early as the tenth week, and by the end of the fourth month the dilatation is increased by the pressure of the pregnant uterus. Dilatation continues up to the sixth month, but from then onwards it diminishes, especially on the left side.

Stasis of the ureters, which is usually present with the dilatation, also reaches its maximum at six months. Renal function up to this time may be quite good but towards full-time become less efficient. According to Baird the best films are obtained at six months, when the kidney excretion is still good and the delay in emptying is at a maximum. The dilatation is due to more than the actual pressure of the enlarged uterus, as tumours of a similar size in the non-pregnant women do not cause the same urinary tract disturbance. The endocrines, no doubt, play an important part.

PELVIC FORMATION AND PELVIMETRY

By radiography it is possible to obtain an exact picture of the pelvis and of all the many variations in the structure to which reference has been made in Chapter XXX. Here the writer is more

particularly concerned with mensuration of the pelvis by means of X-rays. Several methods have been devised, but the basis of the one in common use to-day is to take films of the horizontal brim, cavity and outlet, and to calculate the actual dimensions from the shadows presented.

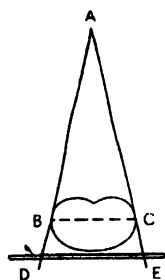


Fig. 500.

In all films a certain amount of distortion takes place. The shadow of the object on the film is always larger than the actual size. This is clearly shown in Fig. 500: A=tube, BC=pelvis, DE=film. As AB, AD and DE are known, BC can be calculated

thus, $\frac{AB}{AD} \times DE = BC$.

Pelvic Brim.—In measuring the diameters of the pelvic brim the film is taken with the patient sitting against a back-rest at an angle of 57° . This renders the pelvic brim horizontal, and rays from the tube strike it at right angles. The boundaries of the brim are very nearly on one plane. A slight error in the level does not result in any serious error in the calculation because of the tube distance now in use. The moving Potter-Bucky diaphragm with film is positioned immediately below the pelvis. The tube is centred and the exposure made.

For mensuration several devices have been suggested, but I shall refer to only two.

In THOM'S GRID METHOD (Fig. 504), when the film has been exposed, the patient rises from the table and a lead plate with small holes exactly 1.25 cm. apart is placed at the level previously occupied by the pelvic brim when the patient was in position. A second exposure is made with the result that one now obtains a picture of the pelvic inlet and the perforations superimposed from which one can read off the formation and measure with exactness all diameters.

ROWDEN METHOD (Fig. 505, p. 1159) makes a series of scales by taking films of a lead strip perforated at $\frac{1}{2}$ -inch intervals at $4\frac{1}{2}$ inches from the film, as did Thom with his grid lead plate. If the pelvis is deeper and the pubic distance is more than $4\frac{1}{2}$ inches, then the scale for $4\frac{3}{4}$, 5, $5\frac{1}{4}$, $5\frac{1}{2}$, $5\frac{3}{4}$ is used. A number of these different scales are kept in stock, the appropriate one being fixed to the finished radiograph of the pelvis and the measurements read off.

Lateral Radiograph.—This is best taken with the patient standing (p. 1139). It is not necessary as a routine but is most valuable if there

is any pelvic deformity, because by means of it one can determine such details in respect to the pelvis (*a*) as obliquity of pelvic brim or superior straight, (*b*) antero-posterior diameters of pelvic brim cavity and outlet, (*c*) the size and shape of the sacro-sciatic notch which is of the very greatest importance; then in respect to the foetus such conditions as presentation and position and size of head.

Both radiologists and practising obstetricians stress the value of a lateral radiograph. Chassar Moir¹ wrote recently: "Of any single view this lateral one is unquestionably the most useful, and is, incidentally, the easiest to obtain."

Outlet Radiography.—The patient sits leaning forward on the Bucky diaphragm containing the film, the idea being to have the



FIG. 501.—Precision Stereoscope. (Caldwell and Molloy.)

under surface of the pubes on the same level as the ischial tuberosities. After making due allowance for the object film distance the diameters of the outlet can be calculated and the depth and angle of the pubic arch can be noted.

Radiography of pelvic outlet is seldom necessary, as very exact measurements can be made manually and with calipers as described in Chapter XXX.

Stereoscopic Methods.—These are much more elaborate methods and demand great technical skill and experience. The Precision Stereoscope (Fig. 501), devised by Caldwell, Molloy and Swenson, is the latest form. It is described and figured in *The Proceedings of the Royal Society of Medicine*,² who have kindly permitted us to reproduce this illustration.

¹ *Edin. Med. Journ.*, vol. xlviii., p. 361, 1941.

² November 1938, vol. xxxii., p. 1.

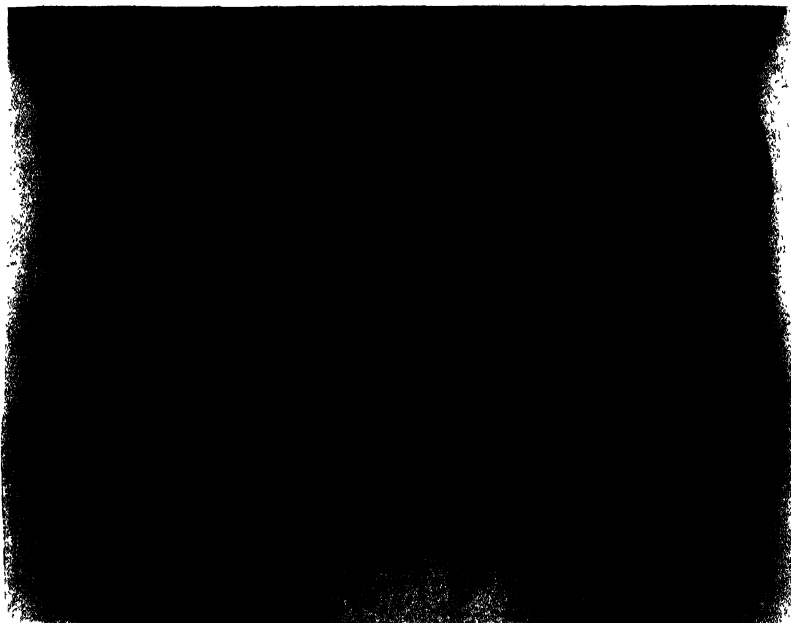


FIG. 502.—Anterior-posterior Pelvis for Measurement.



FIG. 503.—Lateral View of Pelvis.

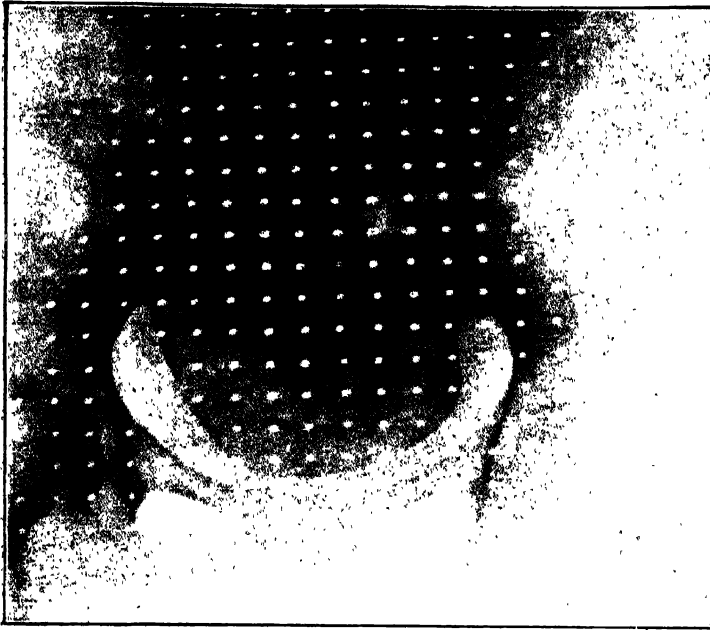


FIG. 504.—Pelvic Röntgenogram, with Exposure of Lead Plate superimposed,

Diameters of inlet are measured by counting number of spaces between perforations, each of which represents 1 cm. (Jarcho, "The Pelvis in Obstetrics.")

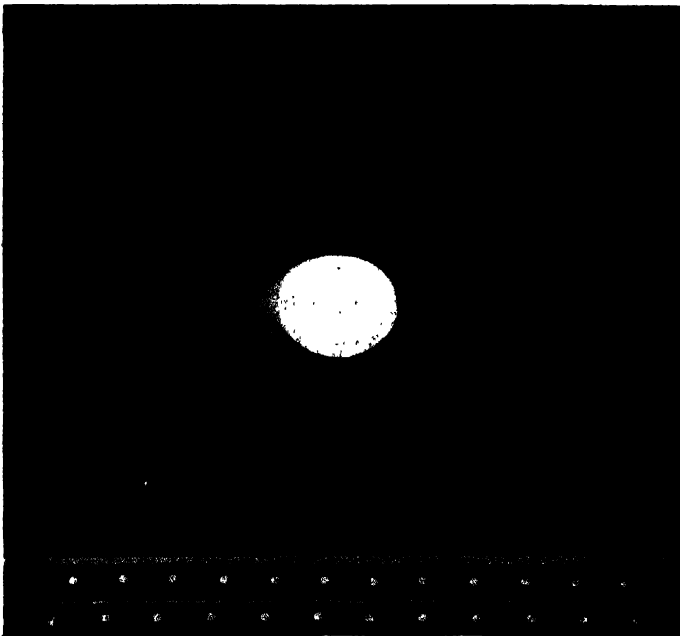
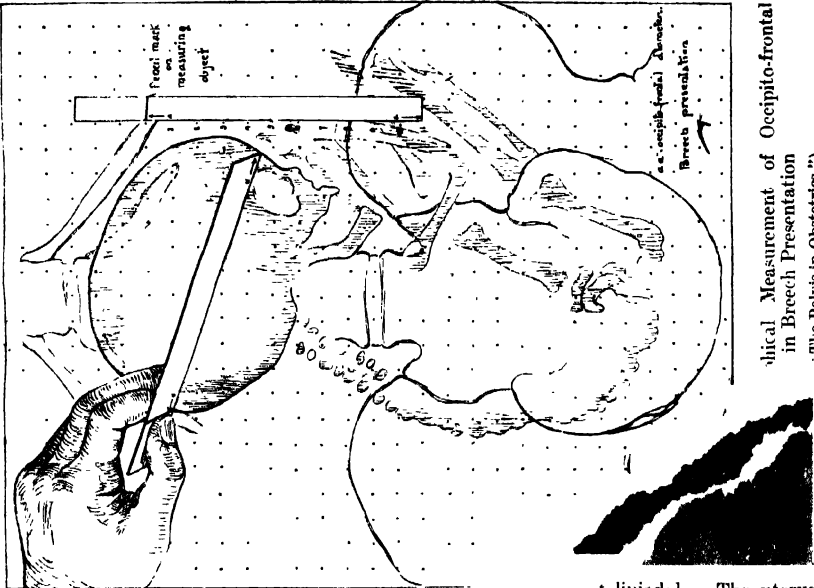
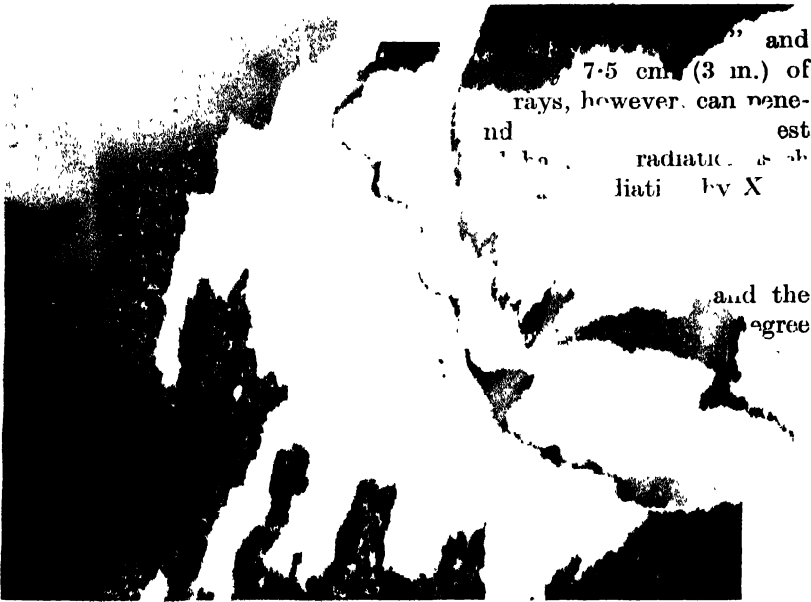


FIG. 505.—Pelvic and Cephalic Radiography.

Age, 26; height, 5 feet 5 inches; primigravida; 8½ months pregnant. Head measurements 3½ by 3½ inches; pubic measurement, 5 inches; cephalic measurement, 7 inches; true conjugate, 4½ inches; lateral, 5 inches; right oblique, 4½ inches; left oblique, 4½ inches. (Rowden.)



at lipiodol. The uterus outside the tubes. Tubes



CEPHALOMETRY

Measurement of the foetal head is carried out similarly to that of the pelvis. If the head can be located and the distance from the film determined the size can be calculated. If the occipito-frontal diameter is parallel to the film the result is likely to be more accurate than if it is slightly rotated showing an oblique view.

VNÆ.

1. REECE.

Lipiodol, 1912.

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patent. If ob-

of the obstacle. It

The pressure exerted

plugged Fallopian tube

should be taken at two

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ne is especially associated with radiographic cephalometry. His original paper did much to simplify the subject. He introduced the use of the biparietal diameter. The skull is ovoid in shape and it must show what he calls "the greatest transverse diameter." The use of tables the biparietal diameter can be determined. There has been a great deal of discussion on this subject in recent years. Recently Cave² made a study of the pressure exerted by the foetal head on the plugged Fallopian tube. The method was described by Reece as "an oblique view." It should be taken at two angles, one occipito-frontal and one occipito-parietal.

The head *in utero* cannot be measured directly. The maternal pelvis. Further-
more, the attitude of the head can be foretold. The attitude of the head as applied by radiographs is discussed in Chapter XXX (p. 527).

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